REPORT.

TO THE TRUSTEES OF KOSCIUSKO STATE PARK
BY THE JOINT SCIENTIFIC COMMITTEE
OF THE LINNEAN SOCIETY OF N.S.W. AND
THE ROYAL ZOOLOGICAL SOCIETY OF N.S.W.

ON

A RECONNAISSANCE NATURAL HISTORY
SURVEY OF THE PARK,
JANUARY-FEBRUARY, 1946.

WITH THREE MAPS AND FORTY-FOUR
PHOTOGRAPHS.

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I. GENERAL INTRODUCTION.

In accordance with the request of the Trustees the Joint Advisory Scientific Committee appointed by the Linnean Society of New South Wales and the Royal Zoological Society of New South Wales organised a Reconnaissance Natural History Survey of the southern half of Kosciusko National Park. The survey was originally planned to last for a full four weeks, and, in particular, it had been hoped to make a fairly extensive series of trips in the area south of Mt. Kosciusko where, it has been suggested, there is country suitable for reservation as a Primitive Area. Unfortunately, for a number of reasons, this programme could not be carried out in its entirety. This was partly on account of wet weather but chiefly because of inadequate arrangements. We had understood that tent accommodation would be provided where other shelter was not available, but this was not done, and consequently, some of the projected trips had to be abandoned; in addition, our guides insisted on returning to the Chalet before the expiry of the time originally allotted to the expedition. It should also be mentioned that we had understood that a camp cook would be available, but none was provided, and the necessity imposed on the members of the party to do the cooking and incidentals for themselves and the guides, together with the lack of certain camping requirements, was a distinct handicap in carrying out the scientific programme.

The party was fortunate in having had the advice of Mr. Barry, Acting Surveyor-General, as to routes and stopping-places, and though, for reasons mentioned above, it was not possible to implement them all, his suggestions were of the greatest value, as with most of the area none of the party was familiar.

The personnel of the party was :-

Messrs. F. Mercer and J. Waterhouse (University) and R.H. Anderson (Director of Botanic Gardens) - botanists;
E. le G. Troughton (Australian Museum) - mammalogist;
K.W. Salter (University) - entomologist;
K.C. McKeown (Australian Museum) - entomologist and ornithologist;
W.H. Maze (University) geographer, and
Drs. G.D. Osborne and W.R. Browne (University) - geologists.

The expedition began on Sunday, 13th January, with the departure from Sydney of six members of the party; Messrs. Maze, Troughton, Mercer, Salter and Waterhouse and Dr. Browne. A week later they were joined by Mr. McKeown, and at the end of the first fortnight, Messrs. Maze and Salter returned to Sydney, and the party was joined by Dr. Osborne and Mr. Anderson. All the personnel had returned to Sydney by Sunday morning, February 10th except Mr. Troughton who returned on February 11th, and Mr. Mercer, who returned on February 12th.

Investigations were directed towards the following principal ends :-

(a) A rapid and generalised survey of the fauna, flora and geological and physiographic features of the

contd.(a) area traversed.

(b) The accummulation of information regarding possible Primitive Areas or Natural History Reserves.

(c) The noting of areas of special scenic beauty or other attractions which might repay development from the tourist point of view.

(d) To study the incidence of soil erosion and its causes.

The members of the party also kept in mind the possibility of completing, at some future date, popular guides or handbooks dealing with the Natural History of the region, and it is hoped that the reconnaissance survey will furnish a basis for further detailed Natural History studies to be carried out, as opportunity offers, in the years to come, the results of which will be embodied in the publications of scientific societies and institutions.

The routes followed, which will be better appreciated by reference to the accompanying maps and the timetables, are as follows :-

Jan.14th and 15th:	Around Hotel Kosciusko, down Digger's Creek to Snowy River, Plains of Heaven, headwaters of Digger's Creek, Boggy Plain, etc.
January 16th :	Party rode from Hotel to Pretty Point, thence along the divide between Snowy and Thredbo Rivers to the Porcupines and thence to the road and on to the Chalet, which became the base for the subsequent trips.
January 17th :	From Chalet north to White's River Hut, where the party remained till the morning of January 21st making trips into the surrounding country, and one detachment riding north to Jagungal (Big Bogong). Rain and mist hampered work at this centre; in particular it prevented an examination of the physiography from Jagungal and necessitated the cancellation of a trip to Grey Mare.
January 21st:	Returned to Chalet.
January 22nd:	Second trip began, the party riding via Hannel's Spur to Geehi Hut.
January 23rd:	Morning spent in the Geehi Valley. In afternoon party rode to Grogin Hut, whence excursions were made on foot into the surrounding country on Jan. 24th and 25th.
January 26th:	Returned to Chalet via Leatherbarrel Spur and Cootapatamba Valley.
January 27th:	Rest.

January 28th/...

January 28th:	Work around the Chalet.
January 29th:	Walk from summit of Kosciusko by the track round the lakes, and back to Chalet. This gave the botanists an opportunity of studying the Alpine flora.
January 30th:	Third trip began, the party riding south to Dead Horse Hut.
January 31st:	Party examined country around Dead Horse Hut in morning. In afternoon rode south to Cascade Hut.
February 1st:	Examined country about Cascade Hut. Heavy rain all day.
February 2nd:	Rode south to Tin Mine Huts. Heavy rain in afternoon.
February 3rd:	Some of party worked about Tin Mine Hut; others rode south via The Pilot to Quambat near the Victorian border at the head of the Indi River.
February 4th:	Some of the party worked around Tin Mine Hut; others rode 12 miles down Ingegoodbee River to Freebody's Hut.
February 5th:	In morning the party rode back to Cascade Hut - some by the Main Divide and Brodie's Camp. In afternoon work around Cascade Hut and Creek.
February 6th:	Work along Cascade Creek in morning; in afternoon whole party rode back to Chalet.
February 7th:	In morning work from Chalet; in afternoon most of the party went to Hotel Kosciusko.
February 8th:	Work from Hotel. Heavy rain and mist in afternoon.
February 9th:	Most of the party departed for Cooma and Sydney.

The general plan followed in the trips was to make such observations as were possible from horseback on the journeys from one base to another (since the cavalcade included packhorses prolonged stops for collecting, etc. were out of the question); then during the sojourn at any base a study was made of the Natural History of the vicinity. This was the best that could be done in the circumstances. The recognised tracks had to be followed, and this precluded the study of the more inaccessible and relatively untouched areas. In all about 250 miles were covered on horseback.

It should be emphasised that the aerial photographs when studied under the stereoscope, have proved of great value, particularly in regard to the glaciology and physiography, in the area covered by them.

II. REPORT ON THE GEOLOGY, PHYSIOGRAPHY, &C.

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GEOLOGY. (See Map 1).

ALTERED SEDIMENTARY ROCKS: The general geology of the region is comparatively simple. By far the greatest area is composed of granite, partly massive but for the most part gneissic. Rocks of sedimentary origin constitute a very small minority of those encountered, and, in the main, they seem to occur as inclusions of great size in the granites. Like the granites, they are probably of more than one geological age.

The best known of the altered sedimentary rocks are those near Mt. Kosciusko itself, which form part of the Etheridge Range. With the granitic rocks of the area, they were noted by Strzelecki in 1845, and his account, couched in quaint and archaic terminology, contains what is probably the first notice of them. They consist of shales and sandstones, now converted into mica-schists, quartz-schists and quartzites, and, so far as known, they form a wedge-shaped mass, flanked east and west by granite which is narrow on the ridge immediately west and south-west of Lake Cootapatamba, forms part of the Etheridge Range at Rawson's Pass and widens to the north, to constitute Northcote Ridge, Carruthers Peak and Mt. Clarke. (Fig.17). It has not been traced farther than this, but may continue north into the gorge of the Geehi Valley, which was not visited.

A small patch of somewhat similar rock was passed over on the track north of White's River Hut a little north of Dicky Cooper Hut; probably it is an inclusion in the granite, but its extent was not ascertained, and on a previous trip, it was noted that farther north on the road from Maathourne to Snowy Plain the high and rough country immediately west of the Eucumbene River rising to Mt. Nimmo and then falling to the west, was of quartzite and slate.

The Big Bogong or Jagungal (Fig.18) in its western part consists of sedimentary rock which has been altered into an intensely hard and siliceous rock by the influence of the granite, which composes the eastern half of the eminence. This rock, which is a true hornfels, is jointed and has been broken up by weathering into a regular "Ploughed field" of cuboidal blocks in the immediate neighbourhood of the Trigonometrical Station. Near the granite-junction it is traversed by quartz-veins emanating from the granite-magma.

From the account given by J.E. Carne in the Annual Report of the Department of Mines, N.S.W. for 1895 it would appear that there are other inclusions of altered sedimentary rock in the granite west of Jagungal in the vicinity of the Toolong Diggings.

On the lower levels of Hannel's Spur, between Wilkinson Valley and the Geehi Flats, the gneissic granite gives way to slaty or phyllitic rocks, which seem to persist down to the floor of the Geehi Valley in the neighbourhood of the hut, as well as on the ridges on the west bank of the Geehi River. Though solid outcrops are rare, there are sufficient indications that the sediments are altered into quartzites and micaceous schists and phyllites very similar indeed to those of the Cooma and Albury districts. These altered sediments were traced south from the Geehi Hut and along the track to Grogin Hut for about 4 miles up the Valley of Bridge Creek.

On the way up the Leatherbarrel Spur from Grogin

Hut to Cootapatamba Valley we passed over a rock-assamblage of phyllite, mica-schist, quartzite and sheared tuff or porphyry, very similar indeed to that just described. This may be a southerly continuation of the schists near Geehi Hut.

In the more southern areas we found sedimentary rocks just south of the Main Divide to the south of Cascade Creek and south-west of Brodie's Camp. These abut on granite and have been very much changed by impregnation with material from the granite magma, which has produced quartzites and highly "micacised" and greisenised rocks. Exactly similar types were found some 14 miles to the south on the left bank of Ingeegoodbee River opposite Freebody's Hut in contact with granite. At the back (west) of Tin Mine Hut, slaty rocks were encountered in contact with granite. In part, at all events, they lie west of Tin Mine Creek, and they continue southward to the Victorian border. These slates make relatively low ground, but to the east they pass into dense flinty quartzites which must be of considerable thickness. These, probably in their thickest part, form the imposing eminence of The Pilot rising to about 6,020 feet, or roughly 1,200 feet above the general level of the surrounding country. (Fig. 19). The elevation falls to north and south, possibly as the result of thinning of the hard rock, but the quartzites can be traced along the motor track from Tine Mines Hut almost from the hut for 12 or 15 miles southward to Quambat near the Victorian border. Near Quambat the beds are seen to be invaded by quartz-porphyry.

None of the above-described formations has yielded any fossils, but on lithological grounds the phyllites and schists are believed to be Ordovician, and the probability is that all of them, including the quartzites and slates of The Pilot and its vicinity, are of this age, though some may be Silurian. All the rocks are metamorphic, but of sedimentary origin; they dip steeply as a rule and generally have a submeridional strike.

An interesting formation was noted near the Victorian border at Quambat Flat. Here the Ordovician (?) quartzites occur on the left or eastern bank of Pilot Creek (flowing south to the Indi) and on the right bank are felsites and felsite-breccias, much jointed. It is suggested that these may be a northern continuation of the Lower Devonian Snowy River Porphyries which, according to the Geological Map of Victoria, have been traced in that State to within a few miles of Quambat Flat. Their relation to The Pilot quartzites could not be determined but it seems possible that Pilot Creek flows along the dividing-line between the two formations, which may mark either a fault or an unconformity.

INTRUSIVE ROCKS: The intrusive rocks are almost exclusively of granites and allied types. So far as we were able to judge on a hasty survey, granites of probably four different geological ages are present in the area traversed.

Late Ordovician: The oldest intrusives are very micaceous, rather fine-grained granites which agree exactly with the Late Ordovician intrusives of the Cooma and Albury areas, and have been recognised in other parts of the State as well as in Victoria. These were noted near the Geehi Hut but were encountered in force in the Bridge River valley about 4 or 5 miles south of Geehi Hut. They must continue south of this a little west of the track, for in the neighbourhood of Grogin they crop out strongly

on the Victorian side of the Murray close to the river and have a width of at least a mile between it and its tributary Omeo Creek. Here, a mile or more upstream from Grogin Hut, they rise to a hill which is formed of an acid modification of the granite.

Late Silurian (?) and Middle Devonian (?): By far the larger portion of the area is formed of a gneissic granite which, from its resemblance to similar rock elsewhere in the Monaro country, is considered to be late Silurian age. This is particularly prominent in the Tops country where the absence of trees and the comparative absence of soil render its light grey coloured outcrops very conspicuous. It is seen, for instance, on the summit of Mt. Kosciusko (Fig. 17) and to the north in the Abbot Range. On the eastern side of the Etheridge Range and to the north and south of it, as in the Ramshead Range and its southern extension, a similar rock forms groups of serrated peaks and pinnacles, and north beyond the Blue Lake and down to the Snowy River the strongly gneissic rock is well developed. It may also be followed along the Main Divide to the north where it forms such projections as Mt. Tate, and, though the gneissic foliation is not everywhere so strongly marked, it has been traced through the Kerries and the Main Divide as far north as Jagungal (Fig. 18). South of the Tops country it has been noted as far south as Cascade Creek and the Main Divide just south of it, and this is the southern limit of it, so far as our observations show. On the west, the gneissic granite was traversed down Hannel's Spur, in whose lower levels it gives place to slate and schist and is no more seen. Eastward it extends at least to the Upper Snowy River, but there is much uncertainty as to its ultimate eastern boundary, which only careful and detailed fieldwork will resolve. The granite in situ at Charlotte's Pass, around the Hotel and elsewhere east of the Snowy River is on the whole massive, or has, at best, only a poorly marked gneissic foliation, though to this generalisation exceptions have been noted along Digger's Creek and on the track between Pretty Point and the Porcupines. This massive or submassive granite seems to pass eastwards into the perfectly massive type of Jindabyne and Berridale (though this latter type has not been noted on the western side of the Main Divide). It may be suggested that the late Silurian gneissic granite has been invaded and partly engulfed by a later massive granite, possibly of Middle Devonian age, and that the latter was not injected west of the Snowy River. The intimate intermingling of massive and gneissic granite east of the river may be due to engulfment of the older by the newer rock.

An alternative suggestion is that the granite is all of one age and that it became locally gneissic through earth-movements during or after consolidation of the magma.

A feature of both the gneissic and the massive granite is the presence in places of abundant xenoliths or inclusions. In the massive granite, these are in the main angular or rounded in shape, as may be seen for example at Charlotte's Pass, but in the gneissic rock they are drawn out into long streaks or schlieren. Where observations were made, the gneissic foliation was found to be in a north-north-east or north-east direction.

Among the massive to submassive granite, particularly but by no means exclusively in the neighbourhood of the Hotel, there are dyke-like intrusions of

microdiorite/...

microdiorite, quartz-porphyrite and hornblende-lamprophyre On various occasions, these have been noted on the Pretty Point track not far up from the road, also south of Boggy Plain, on the southern slope of Alpine View, and along Digger's Creek, near Pretty Point and on Prussian Flat. A splendid outcrop of beautiful hornblende-lamprophyre was observed a few years ago on the track ascending to Brassy Gap from the east.

At various places along the track from Geehi Hut to Grogin Hut, and particularly after the head of Bridge Creek had been passed, out-crops of massive granite were noticed, and it seems probable that a large area north-north-east from Grogin Hut is made of this massive granite, which may be of Middle Devonian age and equivalent to that at Charlotte's Pass and elsewhere. In particular, the wide valley of the Murray at Grogin is carved in this rock, which may be seen in situ in the river near the hut, and forming the river-terraces on the New South Wales side of it. In the ridges to the east, the granite is seen to pass into or be succeeded by more resistant porphyry or porphyrite, and this rock crosses Snowy Creek and forms Leatherbarrel Spur to a point perhaps 2½ miles east of the mouth of Snowy Creek, where it is succeeded by phyllite, etc.

Lower Carboniferous (?): South of the Main Divide where it bounds Cascade Creek, we encountered a light grey granite which continued to Tin Mine Hut, and down the Ingeegoodbee River at least as far as Freebody's Hut. This is a massive granite which, on its western margin near Tin Mine Hut passes into an acid phase, aplite and alaskite and coarser, almost pegmatitic, quartz-felspar rock. It is alleged to carry tin at and near its junction with the slaty rocks, but we were unable definitely to verify this. It is this granite which on the left bank of the Ingeegoodbee River at Freebody's Hut has converted the neighbouring sedimentary rock along its eastern margin into a micaceous hornfels and greisen, and just south of the Main Divide at the head of Cascade Creek has effected a similar transformation. The only reason for believing that this rock is possibly Lower Carboniferous, apart from its massiveness, is the fact that rocks of this age in New South Wales and possibly Victoria also are accompanied in places by tin and/or wolfram, molybdenum and bismuth. The main rock contains tiny crystals of megascopic sphene.

In the neighbourhood of Quambat Hut, the Ordovician (?) quartzites are invaded in places by massive quartz-porphyry of unknown age. Though appearing very abundantly as waterworn pebbles and boulders in Pilot Creek, this rock was not encountered abundantly in situ. It is probably of Middle Devonian or Lower Carboniferous age.

ECONOMIC GEOLOGY.

In the Plains of Heaven and on the tops south of the Chalet are signs of former "diggings" from which some gold was obtained many years ago, but these have long been abandoned. At the Tin Mine Hut we found an old gentleman who was still hopeful, after seven years of unrequited labour, of getting tin and gold. Quite probably there is tinstone in the acid granite near its intrusive junction with slates, and if so, there must be some alluvial tin in the watercourses, but the evidences of abandoned attempts to win it suggest that it

is not present in quantity.

We understand there was formerly a copper mine in the vicinity of the Big Bogong Swamp but this has been abandoned, and that alluvial gold-digging was once carried on on Macdonald's Creek, north of Alpine Hut. In the area traversed by us, however, we saw no evidences of valuable ore-deposits.

PHYSIOGRAPHY.

A full elucidation of the physiography and its evolution could come only if at all after long and detailed study in the field. Here one can only record such facts as came under notice, and make suggestions as to their interpretation.

FAULTING (?): An account of the views of two of the authors on the physiography of part of the area will be found in a paper in the Proceedings of the Linnean Society of New South Wales, Vol.LXIX, 1944,p.238.It may be said here that observations made on this trip tend to confirm some of the suggestions made in that paper. In particular, the conception of a series of steps, possibly produced by step-faulting to the east along the eastern margin of the Kosciusko block, appeared to be reasonably sound where the country was viewed from such vantage-points as Pretty Point, Alpine View and the country east of Boggy Plain and south of the Kosciusko Road. The idea of a Perisher block faulted up above the Pretty Point or 6,000 foot level also appeared reasonable, the boundary-line passing just north of the Porcupines and along Perisher Creek. Not enough, however, was seen of the country to enable one to say if these apparent fault-blocks are continued far, or even if they are continued at all, to north and south, and no definite evidence was obtained in regard to the question whether the highest country - that over, say, 6,700', around Kosciusko - is an upfaulted block or merely a series of physiographic residuals. We saw some of this country from many angles - from Geehi Hut (Figs.20 & 21), the hills around Grogin Hut, The Pilot, Purgatory Hill and elsewhere - and traversed the country between it and lower levels on the west and the south, and nowhere could we see any signs suggesting that it might be faulted up; all the evidence, such as it was, indicated erosion-residuals.

The natural complement to faulting of the plateau down to the east is faulting on the west,and any physiographer who has ridden and slidden down Hannel's Spur to Geehi Flats will surely be prejudiced in favour of faulting as a probable explanation of the abrupt change in level between the tops and the lower country, especially when in addition he has viewed the impressive heights of the Abbot Range and Mt. Townsend from the comparative lowliness of Geehi Hut. It is not, of course, to be supposed that the whole difference in altitude between Mt.Townsend (7,241 ft.) and the Hut (1,340 ft.) is to be explained by faulting; much is due to erosion by the Geehi River and its tributaries, but even when this is allowed for there is still a big difference between the altitudes of the hills to the west and those of the Kosciusko block, amounting perhaps to 2,500 or 3,000 feet. The main faulting, if such it is, would run probably in a submeridional direction and pass perhaps 1½ miles to the west of Mt. Townsend, if not more. From Geehi Hut it appeared as if the fault might pass south along the Valley of Geehi Creek (Fig.22) whose extraordinary

lends colour to the suggestion. It may be, of course, that there has been step-faulting with two or more steps. This suggestion of faulted western boundaries to the Kosciusko highlands and their northern continuations is by no means new; it was made, for example, by Sir Edgeworth David nearly 40 years ago, and the rather abrupt fall from the highlands to places like Tooma, Tumut and Gundagai has been tentatively ascribed to faulting in part.

Riding north from Tin Mine Hut to Cascade Hut, we branched off from the main track a little north of Joe Dudley's Flat on Packsaddle Flat Creek and, going between east and north-east, came eventually to a steep scarp about 550' high which we climbed to the Rollo Lookout. This scarp marks the Main Divide in the neighbourhood, about 5,200 feet above sea-level. The impression received is of a fault-scarp running perhaps east-west or east-north-east. On the geological side the evidence is that on the lower ground the rocks are massive Carboniferous(?) granite and greisenised sediments, whereas, as soon as one starts to ascend the scarp, there seems to be an abrupt change to the gneissic granite which composes the country to the north. Secondly, when one looks south from the top of the Main Divide ridge there lies before him, stretching to the south and south-west for more than 15 miles a comparatively low land with an average altitude of perhaps 4,500 feet, with The Pilot rising as a great physiographic residual to some 1,500 feet above it; in the distance, the highlands of Victoria rise again well above the 4,500 foot level. Lastly, a study of the map shows that in this vicinity the Main Divide for a space runs due east-west and is offset, as it were, while the headwaters of Pinch River flow directly west towards the Indi and only turn South-east towards the Snowy when they are within a little more than 2 miles of the former river; this behaviour suggests some derangement of the drainage and possible river-capture, such as might have been caused by faulting.

At White's River Hut, it is noticeable that the ground rises in a series of terraces westwards to the Main Divide, the total lift being about 800 feet in about seven-eighths of a mile horizontal. There is a suggestion of step-faulting here, but the matter requires much closer investigation and the appearance of faulting may be illusory.

THE MAIN DIVIDE: The variation in the character of this most important physiographic feature is very striking. In some places it deserves the name of Main Dividing Range, in others it is so insignificant as to require careful search before it can be determined. Everywhere it is the result of erosion, but in such places as at the head of Macdonald's Creek (Fig. 23) and west of White's River Hut it is for short distances made of such unconsolidated and easily eroded material as glacial moraine. In the north it is a relatively insignificant feature and is dwarfed by the range known as The Kerries lying to the west of it, and it passes well to the east of the most striking eminence of the neighbourhood, Jagungal, as well as some minor peaks which nevertheless overtop it.

From Gungartan to Mt. Tate and beyond it is a real ridge, though not an outstanding one, and farther south still where it passes through Mt. Twynam (Fig. 25) Carruthers Peak, Mt. Northcote, Mt. Kosciusko and Rams's Head, the highest collection of peaks in the Commonwealth,

it is/..

it is deserving of the name of 'range'. Beyond Dead Horse Gap, however, it loses its prominence and, though containing such high points as Purgatory Hill, Jerusalem Hill and Paradise Hill, all about 5,900 feet, it is by no means spectacular. Looking south and south-east from the Rollo Lookout west of Brodie's Camp, above described, one finds it hard to trace the Divide on the 4,500 foot surface; it seems to be an insignificant water-parting except where it is formed by the prominent submeridional ridge of The Pilot (Fig.19). It runs just to the west of the Tin Mine Hut in a low ill-defined flattish ridge, swampy in places, about 150' above the Ingeegoodbee River and Tin Mine Creek. It is noteworthy that in this southern part of the region the Divide is much closer to the Indi or Murray than to the Snowy; the tributaries of the latter seem in the past to have been much the more vigorous.

PLATEAUX: From many vantage-points it can be seen that the country under review is of the nature of a plateau. If the suggestions made above concerning possible faulting are correct then the original continuous plateau has been in part broken up into plateau-remnants at different levels, but, in addition, it has been much dissected and modified by river-action and glaciation, and its history has been rather complicated. That the plateau was once a peneplain with a level or undulating surface is evident from the level skyline of its remnants which can be observed from various points (Fig.26). We notice it, for example, when looking from about Pretty Point towards the Porcupines and the Perisher or from the Plains of Heaven to the west towards the Main Divide, or from Gungartan west towards Grey Mare ridge. From Purgatory Hill a level skyline is seen to the north, and from the Main Divide at Rollo Gap ridge the undulating and dissected surface of the plateau at about 4,500 feet is well seen to the south. From Grogin Hut and thereabouts a flat-topped plateau can be seen on looking up the Murray River (Fig.27). Lastly, from Jindabyne and the hills to east and south-east of it a fine view can be obtained of the remarkably level skyline which marks the edge of the Kosciusko plateau as seen from there.

A number of physiographic residuals great and small rise above the general plateau-surface. As mentioned above, it would appear that the cluster of eminences around and including Mt.Kosciusko itself really form remnants of an older surface which have not been reduced to the general peneplain level, and to the north the most conspicuous remnant is that forming Jagungal, whose superior altitude has been accentuated by river-erosion all around it (Figs.17, 18, 24). Other smaller residuals in this northern area are Bull's Peaks, Mailbox Hill, Cup and Saucer Hill, etc. In the south, hills like Purgatory, Jerusalem and Paradise give the impression, from their isolation, of being higher than the surrounding plateau level, and this may be so, for they are certainly higher than the Main Divide at Rollo Ridge, but it is a matter on which one cannot be certain. The most outstanding residual in this southern area is The Pilot (Fig.19), a submeridional ridge of hard quartzite rising to a height of just over 6,000 feet and gradually descending to north and south. It has survived because of the great resistance of the component rock and its north-south arrangement, and now towers perhaps 1,200 to 1,500 feet above the surrounding plateau-surface. From its top one can see away to the south in Victoria a somewhat similar residual, Mt. Cobberas (Fig.28). Other residuals in this area include Mt.Leo and The Chimneys near the head of The Big Boggy.

On the day of our farthest north trip to Jagungal, from which we had expected to get good physiographic views, it was unfortunately so misty that visibility was nil. An inspection of the topographic map, however, makes it fairly clear that this point marks the limit of the high country, that to the north being less than 6,000' high. Whether the sudden change in the level of the plateau is due to faulting we cannot say.

RIVERS: The region contains the Main Divide separating the Indi or Upper Murray on the west from the Eucumbene-Snowy on the east, and the drainage runs into one or other of these trunk-streams, the former flowing north, the latter in a general southerly direction. The biggest tributaries of the Eucumbene-Snowy in the region are the Upper Snowy, Thredbo or Crackenback and Wollondibby; of the Murray the biggest tributary is probably the Geehi. Many anomalies of flow-direction are apparent on a scrutiny of the map, to some of which attention has been called by various writers. For instance, the Upper Snowy, Thredbo, Wollondibby, Mowamba and other Snowy tributaries flow to the north-east though the trunk-stream flows south, and the Geehi River and Bogong Creek flow south-south-west before uniting to form the Swampy Plain River which turns to join the north-flowing Murray. These and other anomalies are hard to explain; they are not improbably the results of forces which operated long before the original peneplain had been elevated to form a plateau.

An examination of the aerial photographs shows that on a smaller scale there are many curious twists in the drainage, possibly due to the dissection by present streams of glacial-valley topography.

The stream-patterns are interesting, but are as yet unexplained. In addition to the north-east trend exhibited by the Upper Snowy, Thredbo, Wollondibby, Mowamba, etc. there is a south-east trend shown in some rivers, e.g. the Ingeegoodbee, Pinch and Jacob's Rivers and the Gungarlin, Burrungubuggee and part of the Snowy; a meridional, exhibited by the Eucumbene-Snowy, the Upper Murray and the Upper Valentine (Fig. 24); and a south-south-westerly, exemplified by the Geehi River and Bogong Creek. It may be that some at least of these directions have been determined by structures such as jointing and gneissic foliation in the prevailing granite of the region, and some may be related to faulting. It is evident that many of the rivers date back to the early days of the plateau, for, in their upper courses and headwater tributaries, they meander about in flat shallow mature to senile valleys, and it is only when traced downstream that these are seen to pass into deep gorges. This is well seen in the Snowy from its head under Mt. Kosciusko to its emergence near the Creel from the Kosciusko block. It is also noticeable in those tributaries of the Snowy such as Perisher Creek, Pipers Creek etc. which flow in the vicinity of the Kosciusko Road, also in some of those like Munyang or White's River, (Fig. 29), which come in on the left bank. From the western side of the Main Divide in the 'Tops' country, the rivers descend much more quickly and the country is much more precipitous than on the eastern side (Figs. 20 & 22); this is because their parent or trunk-stream, the Murray, is flowing at a much lower level than is the Snowy in the same latitude. In the north, the Gungarlin and Burrungubuggee Rivers show marked deepening downstream and so does the Geehi as well as its tributaries the Valentine,

Dicky, Cooper etc. Farther south, the river in the broad valley known as the Big Boggy, flows west and then north-west, gradually deepening and becoming more V-shaped in cross-section till it turns sharply near Dead Horse Gap and forms the youthful gorge of the Crackenback River (Fig.30). Another stream exemplifying the same peculiarity is Cascade Creek which is typically mature for about 3½ miles from its head (Fig 31) when it becomes rejuvinated and deepens rapidly to a gorge as it makes for the Murray. Other streams which are very mature in their upper courses are Tin Mine Creek, the Ingeegoodbee River and Pinch River. The valley of the second of these was traversed for about 12 miles from Tin Mine Hut down to Freebody's Hut. A meandering stream in a boggy bed at the head, it becomes a little less senile on the whole downstream, but at Freebody's Hut, where it had dropped some 850 feet, it is still flowing in a mature valley, though boggy flats have disappeared (Fig.32). Where the track crosses it at intervals, it is seen to be meandering across grassy or boggy flats, and one would infer that it passes downstream in alternating flats and rapids. Apparently, it becomes rejuvinated a mile or so down from Freebody's Hut. From a distance, Pinch River, which serpentines in places, in a swampy plain near its head waters, appears to descend towards the Snowy in a deep gorge, and this is said to be very rough and almost impassable.

From the scanty observations we were able to make, which are confirmed by the air photographs, it would seem that the tributaries of the Thredbo River from both sides behave in a somewhat similar manner, flowing in flat and even swampy valleys at the head and steepening rapidly in gradient as they approach the parent-stream.

Extensive river flats were observed on the Geehi at Geehi Hut and on the Indi at Grogin Hut (Figs.20 & 27). It would seem that these, and probably other similar flats which appear on the aerial photographs, are due to special local causes. That at Grogin seems to be caused by the erosion of a mass of granite which has been less resistant than the hard porphyry to the east and the acid granite on the west. The reason for the Geehi flats was not apparent; the valley here is cut in schist and quartzite, and it may be that the river has excavated its bed in a belt of relatively soft schist. The valley flats seem to close in both up and down stream to be succeeded by gorges (Fig.44), so that the producing causes are essentially local in character and probably related to the nature of the component rocks. In this connection, it may be noted that on the track from Geehi to Grogin Hut, which follows the valley of Bridge Creek, much of the country is open and the valley has a wide flare. It appears to be cut in Ordovician schist, but as the track winds upward to the head of Bridge Creek and the highest part of the route, this gives place to Ordovician granite. Farther south towards Grogin, the country falls and opens out again in less resistant granite.

It may be pointed out here that in the higher levels, down to about 4,800 feet above sea level, many of the river valleys have been modified by the passage of glaciers. The description of the glacial topography is reserved for the next section.

GLACIATION/...

GLACIATION (Map 2).

The glaciation of the Pleistocene Period or Great Ice Age was of very much less importance in Australia than in many other parts of the world, and on the mainland its effects are, so far as we know at present, confined to the higher parts of the Kosciusko Plateau. It is possible that they may eventually be found to extend to the highest levels in the A.C.T. and one of us (G.D.O.) who is familiar with the Barrington Plateau, north of the Hunter Valley, considers that the upland valley topography there closely resembles that attributed to glaciers in the Kosciusko region. On a priori grounds one might expect also to find signs of the glaciation in some of the highest parts of north-east Victoria, which exceed 6,000 feet in altitude, and from vantage points in the southern part of the Kosciusko region, one could almost discern, with the eye of faith, cirques and other glacial features in the distant Victorian hills.

To the geologist and the geographer, the vestages of the vanished Kosciusko ice sheets provide a never failing source of interest. Much has been written about them, particularly by Sir Edgeworth David and his collaborators, but it should be pointed out that almost all the work has been in the nature of reconnaissance, and much detailed examination and mapping yet remain to be done. Moreover, until two years ago, investigation had been confined to a belt between the Upper Snowy and Crackenback Rivers, running from Ram's Head to the Hotel and Boggy Plain. In 1944, glacial evidences were recognised farther north in the country around the Kerries, Big Brassy and the neighbourhood of the Main Divide thereabouts (Figs. 23 & 24). The present survey has served to prove that the glaciated area extends north to the Big Bogong (Jagungal) and south to at least as far as the heads of Cascade Creek - a distance of about 25 miles in latitude - while the recognition of morainic material down to altitudes of about 4800 feet above sea level at Boggy Plains and in Cascade Creek (Fig. 31) raises the hope of extending still further the known glaciated area by looking for evidence in all country above that height. An inspection of the Lands Department map shows that there is a wide expanse of country in which such traces are possibly to be found. Previous to this survey, traces of glaciation have not with certainty been recognised below about 5000 feet. On the accompanying map (Map 2) the known glaciated areas and the probable original maximum extent of the glaciation are shown. The total glaciated area was probably of the order of 350 sq. miles.

There appear to be evidences of three phases of the Pleistocene Glaciation, spread out over an interval of many thousands of years, and perhaps separated by interglacial stages or phases. First was an ice-cap glaciation which probably extended over the maximum area to be covered with ice. The second phase or stage manifested itself chiefly in valley glaciers which hollowed out pre-existing river valleys as they passed down them, and gave them a generally straight course and a U-shaped cross-section. The third and latest phase, a cirque glaciation, affected only the highest parts of the plateau, roughly speaking, those above 6000 feet. It is not everywhere possible to separate the cirques of this phase from the same cirque-like hollows forming the heads of valleys belonging to the second phase.

Relics of the ice-cap glaciation, chiefly in the form of ground moraine and roches moutonnees, are numerous in the 'Tops' country, where boulder strewn slopes and boggy

flats extend/...

flats extend from well south of Ram's Head as far north as Digger's Creek, and on the western side of the Main Divide about Mt.Townsend and Lake Albina (Fig.40). To the north the tumbled boulders of the ground moraine, the spaces between them filled with mint-bush and other plants, are to be seen west of White's River Hut at intervals west of Gungartan and elsewhere in The Kerries, and along the Main Divide to beyond Bull's Peaks. In the south, too, they were observed on the high ground on the Divide between Dead Horse Hut and Cascade Hut and as far as the head of Cascade Creek, and it seems not improbable that the Main Divide there marks the southern limit of the former ice-cap.

Roches moutonnees, or what are thought to be such, are not infrequent, and many of them, like Mt. Wheatley, (Fig.33), are of considerable size. It is probable that Mr. Vernon, near Daner's Gap, is another, and indeed there are many hills or ridges in the area between Mt. Kosciusko and the Hotel, with gentle slope to the west and steep to the east, which are probably to be regarded as roches moutonnees. Some have been noted in the north, too, like Big Brassy and Brassy Peak. There are many hills in the south which from certain aspects have the asymmetrical profile of roches moutonnees, such as Paradise Hill (Fig.31), but the appearance may be the result of weathering and erosion along inclined joint-planes in the granite. In any case, they have been much modified by post-glacial erosion.

Many hills and ridges of rugged and serrated profile may have been nuntakr (rocky peaks which projected through the ice-sheet) though this would be difficult to prove. Of such are the Dead Horse Ridge, Ram's Head and the serrated ridge south of it, Mt. Stilwell near the Chalet and a host of others. It is possible, too, that Gungartan and Jagungal were of the same nature.

Of much interest are the boulder-strewn flats and cols which are such a feature of the glaciated country. There is little doubt that the boulders were dumped by ice-sheets and the lobes which descended from them, and the cols appear to have formed easy passages over the ridges for the ice-sheets and later, in the second phase, to have formed ice-divides. The flats in places merge into cols. They are particularly well seen along the divide between the Snowy and Thredbo Rivers from the neighbourhood of the Hotel to the head of the Snowy, Rennix Gap, Boggy Plain, the head of Digger's Creek, Plains of Heaven, Thompson's Plain, the head of Wragge's Creek, Charlotte's Pass, the south-eastern heads of Spencer's Creek - these are some of the most obvious examples, but many more could be added to the list. For the most part, the boulders are large and isolated, but in some places where ice-lobes projected down from the edge of the sheet, as at Boggy Plain, the boulders may be locally piled closely together.

These cols are not uncommon along the Main Divide as at the head of White's River, at Dead Man's Hut, the head of Cascade Creek and Big Boggy, etc. The road from the Hotel to the summit passes over some at Daner's Gap, Piper's Gap, Perisher Gap and Charlotte's Pass.

Examples of glaciated valleys are numerous. One of the most perfect and striking is that of Upper Spencer's Creek, closed by the David moraine. This valley is bounded on the west by the Guthrie Ridge, composed in part of ground moraine deposited by the former ice-cap and later partially

eroded by the valley-glacier. The lower part of Spencer's Creek also shows a fine and characteristic U-shaped cross-section, its floor trenched to a depth of perhaps 20 or 30 feet by the post-glacial stream. The main head of Spencer's Creek is formed of large coalescent cirques, and its floor is the site of three drained lakes, originally dammed by moraine; these were described by David in 1907 (Figs. 25 & 34). Their positions are marked by boggy flats through which the creek winds tortuously. A very fine example of valley erosion by glaciers is provided by Wright's Creek, a tributary of Spencer's Creek, flowing at the back (east) of Mt. Stilwell. It is a shallow U-valley with boggy floor, formed by the coalescence of two or more head water valleys of obvious glacial erosion. Downstream, it suddenly descends into a cirque-like hollow which receives tributaries from right and left. The valley, at the lower level, descends again rather abruptly and turns to the left, at the same time receiving a minor tributary from the east. After a very straight course of about 4000 yards, it descends abruptly to the level of Spencer's Creek - a veritable hanging valley (Fig. 35).

From the bridle-track between Mt. Tate and Twynam Creek an exceedingly fine view is obtained from the glaciated Snowy Valley and its glaciated tributary, Spencer's Creek, the latter being visible right up to the col at its south-eastern head. The valleys along which the Kosciusko road runs, were formerly occupied by valley glaciers, which, like that of Spencer's Creek, eventually made their way towards the Snowy. The golf links at the hotel are in a fine glacial valley with smaller glaciated hanging valleys as feeders, and the glacial floor can be seen from the hotel carrying on down Digger's Creek (Fig. 36). In the upper Snowy and its tributaries, traces of the action of the valley glaciers, in the shape of smoothed floor, truncated spurs and hanging valleys, may be seen to about Pound's Creek, near which the post-glacial stream has cut into the glacial valley floor to the extent of about 40 feet.

Along the Main Divide north of Mt. Tate the U-shaped valley of Windy Creek near its head is typically glacial, and a most beautiful example is furnished by the upper part of Dicky Cooper Creek with its very boggy floor, which, gently sloping for about half a mile descends abruptly thereafter, probably as the result of post-glacial erosion. This branch of Dicky Cooper Creek heads in a col or saddle on the Main Divide which on the other sides gives on to White's or Munyang River, whose valley heading in a cirque-like hollow, is typically glacial as far down as the Hut, just below which it is blocked by a moraine (Fig. 29). Farther north Rocky River valley where crossed by the track from Jagungal to Mawson's Hut, shows a typical glacial cross-section.

In the south, two excellent examples of glacier carved valleys were seen - The Big Boggy and Cascade Creek (Fig. 31). The latter, probably the most southerly in the region to be excavated by ice, has three main headwater tributaries, each starting in a typical col from the other side of which flows a head water of one of the Snowy tributaries. These cols, which are up to perhaps 300 yards wide, are cut out of solid granite, but contain remnants of morainic material in places. The floor of the valley of Cascade Creek is boggy in many places and the Creek meanders over it. Trees are confined to the valley walls. It would appear that the valley was scooped out by the ice which flowed down it into a series of basins, each of which was partly closed downstream by a rock barrier and moraine. At least two of these rock bars can be traced and upstream from them where the water was impounded in the basin the valley

floor is boggy and the creek meanders over it. The original lakes have been drained by the creek cutting through the moraine barriers, relics of which are still to be seen. An intricate series of cirque headed valleys, some of them 'hanging' well above the stream to which they are tributary, characterises the headwater part of the creek and glacial moraine has been traced along the main valley for a distance of more than three miles from its source almost to the point where, as already mentioned, the creek has been rejuvinated.

The Big Boggy was not examined in detail, though it was traversed for a mile or more in its lower part. It appears to be in a general way similar to Cascade Creek, heading in at least two cols, and flowing in a valley whose floor is devoid of trees, but does not seem to be so boggy as that of Cascade Creek. Moraine was observed on the side of the valley up to 250 feet above its floor. As it makes its way towards the big bend near the glacial Dead Horse Gap, the valley becomes somewhat V-shaped in cross-section, and it is not at present clear whether it is entirely glacial. Where it is crossed by the track to Kosciusko at the big bend at a height of about 5,000 feet its floor is full of boulders, but while these are perhaps morainic they may have been river-borne. It is interesting to note, however, that Dead Horse Gap is a glacial col on the Main Divide on the other side of which Dead Horse Creek flows to join the Murray. It is typically glaciated, with U-shaped cross-section for at least two miles and seems to have been, after excavation by ice, filled up with moraine, much of which has since been removed by the Creek, though patches of it are still to be seen in the valley down to an elevation of about 4800 feet, or about 400 feet below the col. There is a quite rapid descent from the col to the valley floor, and this descent seems to be composed of moraine all the way. If then the ice descended 400 feet along Dead Horse Creek, there is no reason to believe that on the other side it did not descend two hundred feet to the present level of the Crackenback which may, therefore, at this point be flowing in a glacial valley.

Mention should also be made, of the two well-known and very perfect lateral moraines the Helms moraine just south of Blue Lake and the Townsend (Fig.41) south of Lake Albina.

The evidences of the latest or cirque phase of the glaciation are to be seen mainly in the highest country, i.e. above 6000 feet. Many of the more prominent cirques have already been described by various observers, but we were able to add some more to the list. Perhaps the most interesting of these is on the eastern side of Mt. Clarke, its western bounding wall plainly visible from the road south of Charlotte's Pass. It is cut in granite-gneiss, and perched on its south-western wall are a couple of minor cirques at different levels, each with a little moraine, and a drained lake. The floor of the main cirque (at about 5900 feet) is thickly covered with moraine material which extends out to form a great breached moraine about 250 feet thick (Fig.37) containing granite blocks one of which is 25 feet long.

At the back or west of Mt. Clarke is another unnamed large cirque (Figs.37& 38) with a floor about 100 feet higher than that of the cirque just described, and north of it is another, in the side of which is a smaller cirque containing Club Lake. The hollowing out of all these has

produced/...

produced great quantities of moraine, chiefly of phyllite which is strewn in hummocky masses in the valley leading out from them; the hummocky structure may be original or the result of erosion, it is not clear which. Down the tributary of the Snowy which leads from all three cirques is a great moraine about 150 feet thick or more, containing blocks of phyllite up to twelve feet long and one great conspicuous granite erratic 25 feet long.

Several cirques were noticed on the eastern side of Ram's Head Range west of the track leading from the Kosciusko Road to Dead Horse Hut both in the Snowy headwaters and in those of the Crackenback. These were not examined, but it is very probable that many cirques and moraines will be found along the front of this ridge. It is an area that should well repay detailed exploration.

Along the western side of the Main Divide, cirques and great bowl-like valleys scooped by ice are numerous and are probably much more common than we observed them to be. The Cootapatamba valley is such a bowl-shaped rather elongated depression, most impressive when viewed from the bridle-track where it crosses its southern rim (Fig.39).

Under Mt.Kosciusko is a kind of shelf which seems to have been formed perhaps by the union of two or more cirques. One of these is hung well above the Wilkinson valley, into which it is drained over a waterfall. The north-eastern head of Wilkinson Valley immediately to the west of the lowest part of the saddle connecting Mt.Kosciusko with Mts.Townsend and Clarke is a large bowl-shaped hollow containing a drained lake with boggy floor through which the Creek meanders (Fig. 9). After winding down Wilkinson Valley and rising on its northern side, the track to Hannel's Spur turns sharply to the north, and traverses the floors of two large adjacent cirques at heights of more than 6000 feet. From the Geehi Hut it would appear that there are two other cirques or bowl-shaped depressions north of Mt.Townsend,but these were not seen at close quarters.

Lake Albina, of course, is in a bowl (Fig.40),and it appears not improbable that a number of the small creeks and gullies heading in the west of the Main Divide between Lake Albina and the Blue Lake were originally cirque-like and have been modified by river erosion. The Blue Lake is a cirque lake, with another cirque 250 feet above it (Fig. 42).

In the highland forming the Perisher group one large cirque has already been noted by Taylor, Browne, and Jardine and distant views of the Blue Cow (from the Plains of Heaven and from the track between Mt.Tate and Snowy River) suggest that there are a number of cirque-like hollows high up in this and adjacent eminences and facing both east and west. A number of cirques and bowls have been noted in the high country north of Gungartan, the most northern being that immediately south of Jagungal at the head of the Tooma River. At the back (west) of White's River Hut and extending upwards to the Main Divide at an altitude of about 6300 feet there are terraces and hanging valleys(already mentioned) some of which have the apppearance of shallow cirques and large bowl depressions, and to the south, going towards Mt.Tate, one sees somewhat similar circular heads to tributaries of the Snowy. Just over the Divide at the back of White's River Hut a tributary of Windy Creek heads in a large shallow depression with gently sloping sides and partially blocked with moraine which emerges downwards into

another/...

another similar structure. These and other depressions just described are not of the nature of true cirques, because of their size and shallowness and the gentle slope of their sides and perhaps they should have been called saucer-shaped instead of bowl-shaped hollows. Whatever their classification, however, they are clearly of glacial origin.

Incidentally, some mention should be made of certain pseudo-cirques caused by landslips. Two of these are to be seen on the slope behind White's River Hut near the Main Divide; the movement of rock has been facilitated by the abundance of loose moraine-material about. No doubt, similar structures could be found elsewhere.

Some note should also be taken of small cirque-like hollows, a few of which are to be seen on the eastern side of the Main Divide in the neighbourhood of the Blue Lake, and south of White's River hut, and which are caused or being enlarged by present-day nivation.

Finally, before leaving the matter of glaciation, it should be noted that a distant view of the country to the south-east of the Crackenback River from about Mt. Stilwell strongly suggests the presence in it of glacier-carved valleys now hung up well above the floor of the Crackenback Valley. The map shows a series of swampy flats at the head of such creeks as Friday Flat, Bullock Yard and others, and it seemed to us that the glaciation might well have extended to the high country between the Crackenback and Wollondibby Rivers. One can envisage the possibility of high-level valley-glaciers in these uplands, tributary to the main valley-glaciers of the Upper Crackenback and Upper Wollondibby Valleys; the tributary valleys on the retreat of the ice, being left as hanging-valleys which have since been eaten into by post-glacial erosion. The area is well worthy of investigation.

SOIL-EROSION.

We saw many evidences in the course of our trips of destruction of the soil by both gullying and sheet-erosion.

Perhaps the worst of these are to be found in the Tops country in the neighbourhood of the most frequented parts. There is no doubt that human occupation, centred at the Hotel and the Chalet, has seriously interfered with and upset the balance of natural processes. This is, of course, to some extent inevitable. It is a well-known fact that human activities tend to accelerate erosion, but it is known, too, that when these are properly controlled the damage is considerably reduced. Unfortunately, in the past the conditions of occupation have not favoured such control, and even now, they make control somewhat difficult.

The texture of the soil and the nature of the soil-profile make for easy and rapid erosion once this is started. Over most of the area the rock is granite, and this has, through the conditions of weathering which prevail, broken down into angular fragments nearest the solid rock, passing up into very coarse sand and grit. In most places, this is overlain by or passes up into a surface-layer rich in humus, and once this is broken through, the underlying porous coarse material is quickly removed. Where, in the Tops country, the rocks are of phyllite the soil is relatively thin, and in

addition/...

addition to the micaceous clayey material of which it is composed, there are in places abundant quartz-fragments derived from veins through the phyllite.

Erosion is encouraged by the steepness of most of the slopes, and, above the 6000 foot level, by the absence of trees, though at these levels, it may be pointed out, the cover of snow which exists during a substantial part of the year is a protection. Below the tree-line the killing of trees, chiefly by bush-fires, has promoted soil-erosion extensively.

In the vicinity of the Hotel, clearings and dead trees are all too abundant, and there are many signs of soil-removal, as, for example, on the western slopes of Alpine View. Similarly around the Chalet, the cover of vegetation and soil which formerly concealed much of the loose boulder-strewn surface has been removed; this is well seen along the western sides of the Valley of Spencer's Creek between the Summit Road above and the road to the Chalet below. Hereabouts the processes of erosion have been, no doubt, hastened by the depasturing of animals on the steep slopes behind the Chalet, and the absence of scrubby vegetation, and the outcroppings of bare rocks are quite noteworthy in the horse-paddock. The soil in the banks of Spencer's Creek down from the Chalet is being definitely eroded, and here and there a certain amount of deposition of sandy material derived from higher up is proceeding.

The grazing of sheep and cattle on much of the Tops country has been very injurious to the soil. Probably, the very worst examples of soil-erosion are to be seen along and from the track between Carruther's Peak and the Blue Lake. The eastern slope of the Main Divide here is in a dreadful condition of erosion which appears to be getting worse with the passage of time (Fig.43). We understand that animals are no longer pastured here, for the damage was done in the past, and it would be difficult now to devise means to check it. On the high ground at the back of the Chalet behind Mt. Stilwell in the Valleys of Wright's and Trapyard Creeks, erosion of the granite soil is proceeding, and patches, small at present, but destined to increase in size, are to be seen from place to place, of bare ground, covered with small granite spalls - the remnant of the soil which was once there, and which included A and B horizons but is now reduced to the C horizon. The restriction of the number of animals which may be grazed on any lease is calculated to diminish the erosion caused by them, but the process is bound to continue so long as the country is grazed at all.

It was noteworthy that there were signs that the moss or peat characteristic of the boggy floors of many of the upland valleys had been destroyed. This is a most serious matter since these masses of peat act as great sponges to retain the water provided by rainfall or melting snow. Thus the rivers are kept in constant flow with clear water, and flooding and erosion are minimised. With the loss of these peat-mosses there is an increased run-off and, therefore, increased erosion, while, the supply of water being exhausted earlier, the streams tend to dry up where they were formerly perennial. This destruction of moss seems to be due to more than one cause. It is in part a direct result of grazing, the cattle tending to destroy it; but it is also largely the result of grass-fires. We know that such fires are deliberately caused by those who wish to see the coarse dry grass replaced by tender green

shoots - a short range policy which is bound to have disastrous results in the long run.

Not improbably the destruction of peaty material, together with the general removal of soil and vegetational cover, has been responsible for the fact, mentioned to us by Mr. Lamble, that the Hotel reservoir which was formerly a perennial source of supply for electricity-generation, has lately been failing quite early in the summer.

We understand that the Big Bogong Swamp in the north of the area which was formerly an extensive swampy area inhabited by wildfowl, etc. has now dried up. We have heard it said that the swamp was deliberately drained so that the peat could be dug for sale to suburban gardeners. If such spoilation is going on, there or elsewhere, it should be stopped immediately in the interests of soil-conservation, and of water-conservation too.

There is much soil-erosion along the bridle-tracks especially where these are on steep slopes. When one track becomes eroded out another one is gradually made alongside it, and eventually a regular braid of anastomosing gutters for the concentration of flowing water may be formed in this way. It is hard to see exactly what counter-measures can be adopted to deal with this.

Almost everywhere we went the ravages of past bush-fires were apparent in acre after acre of dead snow gums. In certain circumstances, and particularly where animals cannot nibble the shoots as they appear, the trees regenerate, but a very large proportion of those we saw are dead. The bush-fires of January, 1939, seem to have been responsible for much of the devastation, but fires have been through some of the country since then. It would appear that many of them originate in the occupied low lands to the west, and travel eastwards and upwards under the influence of the prevailing westerly winds.

The Trustees are doubtless alive to the dangers of soil-erosion within the Park area and to the importance of preserving the highlands as great storage-reservoirs to keep the Snowy and Murray rivers in perennial flow and check flooding and silting in them.

With the increase in tourist-traffic (and the Park is becoming ever more popular with summer walking-parties) there is increased risk of promoting and facilitating erosion through the destruction of vegetation, the careless use of fire and the hundred and one other methods which the perverted ingenuity of the thoughtless and irresponsible tripper finds it all too easy to devise.

PRESERVATION OF GLACIAL FEATURES.

Regarding the preservation of the natural geological features of the area, and more particularly the glacial relics we would emphasize that in the Kosciusko area probably everywhere above say the 4,800 foot level, there are traces of the Great Ice Age which are quite unique on the mainland of Australia. Our observations, supplemented by a study of the available aerial photographs, go to show that these are widespread on either side of the Main Divide from Jagungal south

to beyond/...

to beyond Cascade Creek. It would be a thousand pities if in the process of development of the Park any of these natural features were destroyed. Of course, any sort of settlement in the area in which they occur is bound to interfere with them, but the interference should be reduced to a minimum if the area is to retain in perpetuity what should be one of its chief attractions. Already the building of The Chalet and the arrangement of its amenities at the head of Spencer's Creek have involved some modification and some damage to one of the finest glacial valleys in the area, and this will be aggravated if the building programme is increased.

Some time ago, a few of us pointed out that a road-quarry had been excavated in the David moraine, one of the finest and most spectacular of its kind, a little way past where the summit-road crosses Spencer's Creek. We understood that this would cease, but a second one has since been put in close to the first. We earnestly trust that the Trustees will see to it that this 'official vandalism' by those responsible for the upkeep of the roads is stopped.

May we suggest that if any buildings, quarries, etc. are contemplated in the future the Trustees consult the Scientific Committee responsible for this report? Its members are anxious for the development of the Park for the benefit of the community, but with the retention, so far as is reasonably possible, of the natural history phenomena intact, and they will willingly co-operate with the Trustees to this end.

The question of special Natural History Reserves and Primitive Areas hardly comes within the scope of a geological and geographical report, being chiefly a matter for botanists and zoologists.

AREAS OF SCENIC BEAUTY AND POINTS OF VANTAGE FOR DEVELOPMENT.

Speaking not as experts but as normal citizens with an intelligent interest and appreciation of the beauties of nature, we are of the opinion that some of the sights we saw might with advantage be made somewhat more accessible than they are to the tourist.

One of the most comprehensive views of the Kosciusko Tops on the eastern side of the Main Divide is to be seen from Mt. Stilwell, 1000 feet above the Chalet and just to the east of it, from away south of Kosciusko to Mt. Tate and beyond. A direction-plate or etched map indicating Mt. Kosciusko, Mt. Townsend, the Blue Lake, Hedley Tarn, Mt. Twynam, etc., etc., might be erected on Mt. Stilwell, and would give additional interest to the view after a trip from Kosciusko round the lakes.

The view from Mt. Townsend, in some respects, may be regarded as surpassing that from Mt. Kosciusko. A direction-plate here would be valuable.

The ride from Geehi Hut to Grogin Hut takes one through a wonderful expanse of open forest for the first 3 or 4 miles, and indeed the trip by Hannel's Spur to Geehi Hut, the view from the hut of the Tops rising abruptly to some 6000 feet above the beholder, the scenery along the Geehi River, and the ride to Grogin Hut are, each in its

own way, full of thrills.

The ride up Leatherbarrel Spur from Grogin Hut is likewise through beautiful timbered country, and above this and in strong contrast are first the snow-gum belt and next the bare treeless uplands of the glaciated country of the Cootapatamba Valley. In a few hours' ride quite a kaleidoscopic series of scenic changes is encountered.

Far to the south the view from The Pilot is very wonderful, embracing a very wide stretch of country in every direction, on the east to the valley of the Snowy and beyond to the Jindabyne and Dalgety and Bombala plains, north-west to the Ram's Head Range and west and south far into Victoria across the valley of the Murray. A direction-plate on the top of this commanding eminence would be of distinct assistance and value to those who successfully accomplish the ride to the top.

Another magnificent prospect to the south-west, south and south-east is to be got from the Rollo Lookout on the Main Divide south of Cascade Creek. The view includes the plateau at about 4,500 feet with the valley of the Murray and Snowy Rivers and their tributaries, The Pilot rising abruptly above the general surface, and the Victorian highlands in the distance.

Some of this country to the south, together with more to the north and north-west is well seen from the top of Purgatory Hill, near the head of Cascade Creek.

Though at the time of our visit shrouded in mist, Jagungal (Big Bogong) should command a very extensive stretch of country in all directions, and a direction-plate (or etched map) on top of it could be useful. This plate, like those mentioned above, should contain only the names of peaks or other points or places visible from the point of vantage on which it is placed.

Eventually, it may be found possible to erect signposts indicating features of geological interest. With the aid of these and of a popularly written guide-book, the thoughtful visitor would be able to recognize and study, for example, the major glacial phenomena of the region. We understand that such a scheme is in operation in U.S.A. at Grand Canyon and elsewhere, and is an important factor in stimulating the scientific interest of ever-increasing numbers of visitors. Of course, these indicators once erected would need regular attention and supervision to repair the ravages of the weather and frustrate the depredations of thoughtless and deliberate vandals.

III. REPORT ON THE VEGETATION (Map 3).

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INTRODUCTION.

Little Botanical work has been carried out in the district. Early work dealt mainly with the systematics and descriptive ecology of the area.

Maiden collected extensively about Kosciusko and published a list of plants for the district. "The Flora of Kosciusko", Agric.Gaz.N.S.W. 1898-1899. This account includes a summary of the work of previous investigators.

The only account of the ecology of the area is a paper by McLuckie and Petrie, Proc.Linn.Soc.N.S.W.Vol.52(3), 1927. This gives a general description of some of the plant communities found on the plateau and slopes.

The Natural History Survey Party carried out a reconnaissance survey. Efforts were concentrated on the general botany of the area rather than on any one aspect. This was essential in order to gain most information for the selection of the primitive area and as a foundation for future work. The distribution of the main plant communities was mapped, a considerable number of specimens collected, data obtained on the distribution of species, and the extent of soil erosion and bush fire damage noted.

THE PLANT COMMUNITIES.

The following account illustrates the type of vegetation found in the National Park.

As recognised by McLuckie and Petrie three major vegetation units are found in the park. These correspond with the main physiographic features of the Plateau - the sclerophyll (Eucalyptus) forests of the ridges and slopes draining the plateau, the sub-alpine communities of the upper edges of the plateau and the alpine communities of the high country above 6000 feet.

The survey increased our knowledge of the diversity of the plant communities within the area studied by McLuckie and Petrie. Each contains many different communities which are described below.

The distribution of these is shown on the map included. This shows the distribution in a general manner only, time did not permit the collecting of sufficient information for an accurate map.

THE COMMUNITIES OF THE PARK.

1. Sclerophyll Forests.

   (a) Dry sclerophyll (mixed eucalyptus forest).
   (b) E.gigantea, E.rubida (wet sclerophyll forest)
   (c) E.gigantea forest.
   (d) E.pauciflora forest.
   (e) E.stellulata forest.
   (f) E.pauciflora, E.rubida forest.
   (g) River Bank Community.

2. Sub-alpine Communities.

   (a) E.pauciflora forest.
   (b) Creek communities.
   (c) Grasslands.
   (d) Swamplands.

3. Alpine communities/...

3. Alpine Communities.

(a) Swamps.
(b) Grasslands.

The Sclerophyll Forests are limited to the steep, well-drained slopes of the plateau between an altitude of approximately 1800 feet - 5500 feet. A zonation of the different associations exists in response to altitude and climate.

The Mixed Eucalyptus Forest is found on the hilly country along the Geehi, Indi and Snowy River Valleys at an elevation of approximately 1,700 - 2,500 feet and chiefly on soils derived from granites.

It probably occurs throughout the park in similar habitats.

The community consists of a high forest of Eucalyptus dives, rubida, bicostata, macrorrhyncha and others. The trees are about 80 feet high and grow fairly close together but do not form a closed canopy. Aspect differences and local changes in habitat frequently lead to changes in the dominants.

The undergrowth consists of a varied assemblage of tall and dwarf shrubs. The tall shrub layer is discontinuous and never a characteristic feature of the association. Occasionally local communities of Acacia falciformis, Pomaderris elliptica occur.

The dwarf shrub layer is well developed and at times very dense. The most common are Leucopogon obtusifolia, Mirbelia pungens, Dillwynia ericofolia, Gompholobium sp., Grevillea lanigera, Hakea sp., Acacia sp., Indigofera australis, Daviesia corymbosa.

The ground cover is sparse or absent. Annual plants are not common. Grasses, e.g. Poa, Themeda, Danthonia species occur as scattered tussocks. Doubtless geophytes are common in the spring.

In the vicinity of Geehi and Grogin the community has been much damaged by fire and stock. Regeneration is taking place, and unless further fire damage occurs the community should recover.

The general appearance of the community is shown in Fig. 1.

Eucalyptus stellulata (Black Sally) community is widespread in the Park. The dominant tree, Black Sally, shows a remarkably geographical range growing, as it does, over an altitude range from 1,800 - 5,500 feet.

At the higher altitudes it forms a small fringing shrub community along the edges of the numerous creeks draining the plateau. As the elevation and slope decrease and where soil depth increases, the community develops into a savannah woodland as seen at Grogin and Tin Mine Hut. Shrubs such as Leptospermum, Callistemon continue along the creek bank, but the Eucalyptus spreads out over the flats.

It reaches its best development on these flats, where it forms a semi-closed to open community. Shrubs of all types are rare. Such plants as Banksia marginata, Bossiaea buxifolia, Discaria australis, Hibbertia species, Epacris species, occur sporadically. In places the ground stratum is

well developed - grasses like Themeda, Danthonia, Dichelachne species are common. Herbaceous plants such as Wahlenbergia gracilis, Ajuga australis, Brachycome species, Lomandra species, etc. are mixed with the grass layer.

Figure 2 illustrates the general appearance of the community.

This community has suffered badly through grazing. Along the Grogin track the ground flora is very patchy, grasses and herbaceous plants are not common. Many of the natural members are missing and the floristics of the community have altered. The extent of invasion by such plants as bracken indicates that grazing has been heavy.

The Wet Sclerophyll Forest (E.gigantea and E.rubida).

This occurs from approximately 4,500 - 5,000 feet. It is one of the most beautiful associations to be seen in the Park. The trees form a closed canopy at about 100 - 120 feet high. The dominants have long clear boles and dense heads. E.rubida is frequently smaller than E.gigantea.Aspect plays a large role in determining the distribution of the dominants. E.gigantea favours the wetter habitats and southerly aspects and E. rubida the drier habitats.

The structure is fairly complex, but the undershrub and small tree layer are not so dense as in the other wet sclerophyll forest examined.

A more or less continuous shrub stratum exists in places; in others the underlayers are missing. The commonest are Lomatia longifolia, Veronica Darwentia, Acacia species, Bossiaea foliosa, Olearia megalophylla, Daviesia ulicina, Grevillea species, Persoonia species.

The ground flora is also discontinuous beneath the shrubs, and the main species are Poa caespitosa, Viola hederacea, Dianella Tasmanica, Lobelia species, Lomandra longifolia, Euphrasia Brownii.

Where conditions are drier, frequently at the top of ridges, E.gigantea is replaced by E.rubida, and the undershrubs become less common; some are replaced by other species (Fig.3).

Fire damage in this community has been severe, e.g. Leatherbarrel. In many of the areas visited, it was not possible to obtain a clear picture of the natural structure of the community. Mountain Ash is fire-sensitive and is easily killed. This is unfortunate, as the communities where Mountain Ash grows are amongst the most striking forests found in Australia. (Fig.4)

The Mixed Wet Sclerophyll Forest is the most complex and striking found in the Park. The dominant trees, three or four species of gum, form a closed canopy at 130 feet approximately. Beneath is a smaller tree layer dominated by Acacia species, and tall shrubs are found below the trees. It does not occur much above about 4,500 feet and below about 3,000 feet.

Aspect differences cause local changes in the dominant Eucalypts, so that little pockets occur throughout the forest.

Acacia species, Prostanthera species, Pomaderris apetala, Lomatia longifolia and Coprosma Billardieri form dense thickets.

In the wetter gullies the vegetation is very dense.

Ferns form a luxuriant growth - Dicksonia antarctica and Blechnum species.

Herbaceous plants are common in the spaces between shrubs - Poa, Viola hederacea, Geranium pilosum, Veronica Derwentia, Dichrodra repens, Brachycome species and grasses.

Figure 5 illustrates wet sclerophyll forest.

Modification of structure occurs in drier habitats along ridges.

Bush fire damage has ruined many areas. (Leather-barrel and Hannel's Spur). Regeneration is proceeding and dense layers of Acacia dealbata and Cassinea species are present. Fire damage is probably not so important here as in the Mountain Ash country as the dominant trees are not so fire-sensitive.

E. pauciflora and E. rubida community is found throughout the park from about 3,500 - 5,000 feet where conditions are too dry for Mountain Ash, etc. It is seen over most of the southern portion from Cascade Hut to the border, at Leather-barrel, Hannel's Spur, below the Hotel and above Saw Pit Creek. At intervals throughout this association Mountain Ash is found where local conditions are very damp. Figure 6 illustrates the association.

The community is closed. The dominant trees reach about 60 - 80 feet. Tall shrubs are not common and low shrubs rare. Ground flora is discontinuous. The dwarf shrubs are sclerophytes with hard indurated leaves.

The association is not rich floristically, at least that is the condition during February. It has been suggested that the Tin Mine Hut area be set aside as a Primitive area. From the Botanical viewpoint this would be unwise, as most of the area is covered by E. pauciflora and E. rubida.

Like most of the communities it has suffered badly from fire and grazing. The absence of shrubs and undershrubs may in part be due to these causes.

Local differences in habitat frequently lead to pure stands of the dominants. The undershrubs change very little, if this happens.

The River Bank communities: Throughout the sclerophyll forest the drainage systems running from the plateau to the rivers carry a well-developed fringing shrub and small tree community. The floristic composition of the community varies with altitude, but the physiognomy remains fairly constant. The shrubs grow close to the water's edge and rarely spread more than twenty feet from the creek bank.

At the source of the drainage system and where the soil is poorly drained, a swamp with herbaceous plants, mosses and ferns develops. Many of these plants are interesting. Where this swamp is well developed, ferns such as Blecknum and Dicksonia are common.

Figure 7 illustrates a community of ferns within the Wet Sclerophyll Forest.

As drainage increases, the herbaceous plants and ferns are replaced by shrubs which line the edges of the small creeks. Finally, they reach maximum development along the

permanent rivers/...

permanent rivers. Such plants as Leptospermum species, Callistemon species, Acacia species, Bossiaea species, Lomatia, form a dense thicket.

Frequently Eucalyptus camphora is associated with this dense scrub zone, particularly at levels below about four thousand feet. On the alluvial flats behind this zone E. stellulata association is found.

Figure 8 shows a mature river community.

This community does not appear to have suffered as much damage as the sclerophyll forests in which it occurs. This is fortunate as much of the attraction of the forests is due to the numerous creeks which run through them. It was seen best developed in the area between Geehi and Grogin.

The Sub-alpine Zone contains many distinct plant communities and is limited approximately between 5000 feet to the tree-line at 6500 feet.

The distribution of these communities appears to depend on the level of the water-table. The snow gum forests are confined to the drier hills and slopes where drainage is relatively good. As the slopes flatten out into the valley floor a small shrub community replaces the snow gums; and this in turn gives place to the snow grass sward. On the valley floor where a permanent water table exists the snow grass is replaced by a complex swamp community.

Figure 9 shows zonation of communities.

The Eucalyptus pauciflora (Snow Gum Association). A pure community dominated by snow gum is found between 5,000 and 6,500 feet. Snow gum has an extensive range from 3,000 feet where it is mixed with other eucalypts to 6,000 feet where it forms a monospecific association. At its lower edge it passes gradually into the E. rubida-E. pauciflora Association.

The physiognomy of the community varies with aspect, exposure and altitude. Wherever exposed conditions prevail the extreme mallee form is developed. Beneath the tree canopy it is likely that a continuous shrub layer once existed. The community has been so badly damaged by fire and grazing that it is difficult to determine exactly its former condition.

This community is one of the most interesting in the Park, as it is a mixing zone between the true alpine vegetation of the tops and the sclerophyll zone of the bottoms. Consequently, it is very rich floristically and species from both sources are present.

The quiet beauty of the sub-alpine zone is due almost entirely to the snow gum forests which line the flat green valleys. Unfortunately much of this beauty is impaired as bush fires and grazing have ruined vast areas and regeneration is uncommon. Snow gums are fire sensitive and do not come back rapidly after a bush fire.

The shrub, snow grass and swamp communities have been described in general terms by McLuckie and Petrie and will not be elaborated.

The alpine zone occurs above the tree line. This carries the most interesting plant communities in the Park. Alpine bogs, swamps and meadows are uncommon in Australia, and consequently, this area is of more than usual interest. McLuckie and

Petrie have described, in general terms, these communities. Their descriptions are accurate, but our observations did not coincide with their description in respect to certain important botanical points. This will be referred to again later.

The shrub, swamp and grasses of the sub-alpine and alpine zone are much the same - a few species are limited to the greater altitude. In general, the tops and sub-alpine zone were probably fairly well clothed in vegetation. The fact that isolated patches are found in all aspects and elevations (except the very highest) suggests that the communities carried a semi-continuous ground stratum of herbaceous plants and grasses. Where the ground is rocky the plants are limited to the soil pockets between the boulders (Fig. 10).

THE PLANT SPECIES.

A complete list of the species which occur in the Park is not given. Further collecting is necessary before a full list can be completed. This applies more so to the Sclerophyll Forest Zone. Less time was spent in this area, and consequently less collecting was carried out. Because of the large number of plant communities the flora is particularly rich in species.

Many of the species are related to the flora of Tasmania and the sub-antarctic floral element.

An incomplete list is included to give an idea of the range of species reported from the district. This has been compiled from Maiden, McLuckie and Petrie, from information collected during the survey, and from records at the National Herbarium.

Dicotyledons.

Proteaceae.

Grevillea australis R.Br. 4000' (Sawpit Creek) - Summit.
" lanigera A.Cunn. 3000' (Jindabyne) - 4000' Sawpit Creek.
" Miqueliana F. v M. above tree line - 7000'.
Hakea microcarpa R.Br. 4000-5500'.
" pugioniformis Cav. 3000-4000'.
Lomatia longifolia R.Br. 3500'-5500'.
Orites lancifolia F. v M. 5500' - Summit.
Persoonia chamaepeuce Lhot. - 4000-4500'.

Santalaceae.

Exocarpus nana Hook. 6000'.
" stricta R.Br. 3500'-5500'.
Omphacomeria acerba A.D.C. 4000' - 5500'.

Polygonaceae.

Polygonum prostratum R.Br. about 3500'.
Rumex Brownii Campd. 3000' - Summit.

Portulacaceae.

Claytonia australasica Hook. 5500' - Summit.

Caryophyllaceae.

Colobanthus Benthamianus Fenzl. 6000' - Summit.
Sagina procumbens Linn. 5500' - Summit.
Scleranthus biflorus Hook. 5000'
Scleranthus uniaroides F. v M. 5500' - Summit.
Stellaria flaccida Hook. 5000' - Summit.
Stellaria pungens Brongn. 3500' - Summit.
Scleranthus diander R.Br. 4000'.

Ranunculaceae.

Caltha introloba F. v M. 5,500 feet - Summit.
Clematis aristata R.Br. 4,000 feet - tree line.
" microphylla D.C. 3,500 feet.
Ranunculus anemoneus F. v M. 5,500 feet - Summit.
" Gunnianus, Hook. 5,500 feet - Summit.
" dissectifolius F. v M. 5,500 feet - Summit.
" Millani F. v M. 5,500 feet - Summit.
" Muelleri, Benth. 5,500 feet - Summit.
" parviflorus Linn. 4,000 feet - Summit.
" hirtus Banks and Sol. 5,000 feet - Summit.

Magnoliaceae.

Drimys lanceolata Baill. 4,000 feet - Summit.

Cruciferae.

Barbarea vulgaris R.Br. 5,500 feet - Summit.
Cardamine dictyosperma Hook. 5,500 feet - Summit.
" hirsuta Linn. 6,500 feet - Summit.
" tenuifolia Hook, 5,500 feet - Summit.
Nasturtium terrestre R.Br. 4,000-5,000 feet.

Droseraceae.

Drosera Arcturi Hook. 4,000-5,500 feet.
" peltata Sm. 5,500 feet - summit.

Crassulaceae.

Tillaea verticillaris D.C. 6,500 feet - summit.

Violaceae.

Hymenanthera dentata R.Br. 5,500 feet.

Rosaceae.

Acaena sanguisorba Vahl. 4,000 feet - summit.
Alchemilla vulgaris Linn. 5,500 feet - summit.
Geum urbanum Linn. 4,000-5,000 feet.
Rubus parvifolius Linn. 4,000 feet - summit.

Leguminoseae.

Acacia dealbata Link. 4,000-5,500 feet.
" alpina F.Muell.
" falcata, Willd. 4,000-5,500 feet.
" Kettlewelliae Maiden. 4,000-5500 feet.
" pyenantha Benth. Sawpit Creek.
" rubida A.Cunn.
" siculiformis A. Cunn. Sawpit Creek.
Bossiaea foliosa A. Cunn. 4,000 feet - summit.
Daviesia corymbosa Sm. 4,000-5,500 feet.
" ulicina Sm. 4,500 feet.
Hovea longifolia R.Br. 4,000-6,000 feet.

Hovea/...

Hovea longifolia var. lanceolata 6,000 feet - summit.
Benth.
Lotus australis Andr. 4,000-5,500 feet.
" corniculatus Linn. 4,500-5,500 feet.
Mirbelia oxylobioides F. v M. 3,500-5,500 feet.
Oxylobium alpestre, F. v M. 4,000 feet.
" ellipticum R.Br. var. alpinum M. and B.
3,500 feet - summit.
Pultenaea fasciculata, Benth. 4,000 feet - summit.
" paleacea Willd. 4,000-5,500 feet.
Swainsona phacoides Benth. 4,000 feet.

Geraniaceae.

Geranium dissectum Linn. 4,000-6,500 feet.
" sessiliflorum Cav. 6,000-7,500 feet.
Pelargonium australe Willd. 5,500 feet - summit.

Linaceae.

Linum marginale A. Cunn. 5,500 feet - summit.

Rutaceae.

Asterolasia trymalioides (eriostemon try.) F.v.M.
5,500 feet - summit.
Boronia algida F.v.M. 5,500 feet - summit.
Correa Lawrenciana Hook. 4,000-5,500 feet.
Phebalium ovatifolium F.v.M. 5,500 feet - summit.
" alpinum F.v.M. 5,500 feet - summit.

Polygalaceae.

Comesperma retusum Labill. 5,500 feet - summit.

Euphorbiaceae.

Poranthera microphylla Brongn. 5,000 feet - summit.

Stackhousiaceae.

Stackhousia pulvinaris F.v.M. 5,500 feet - summit.

Rhamnaceae.

Discaria australis Hook. 4,000 feet.

Dilleniaceae.

Hibbertia linearis R.Br. 4,000-5,500 feet.

Violaceae.

Hymenanthera dentata R.Br. 6,500-7,500 feet.
Viola betonicifolia Sm. 5,500 feet - summit.

Thymeliaceae.

Drapetes tasmanica Hook. 6,500 feet - summit.
Pimelea alpina F.v.M. 4,000 feet - summit.
" axiflora F.V.M. 5,000 feet - summit.
" curviflora R.Br. 4,000 feet - summit.
" glauca R.Br. 4,500 feet - 5,500 feet.
" ligustrina Labilla 6,000-7,300 feet.
" linifolia Sm. 4,000 feet.

Lythraceae.

Lythrum salicaria Linn. 4,000-5,500 feet.

Myrtaceae/...

Myrtaceae.

Baeckea Gunniana Schau. 4,000'-7,000 feet.
Callistemon pityoides Miq. 4,000-7,000 feet.
" salignus DC. 5,500 feet - summit.
Eucalyptus species (unclassified).
Kunzea Muelleri Benth. 4,000-7,000 feet.
" peduncularis F.v.M. 4,000-5,500 feet.
Leptospermum lanigerum Sm. 3,000-6,500 feet.
" stellatum Cav. 3,000-5,500 feet.

Oenotheraceae.

Epilobium confertifolium. Hook f. 5,500 feet.
Epilobium glabellum G. Forst. 5,500 feet.

Halorrhagidaceae.

Halorrhagis depressa (A.Cunn.) Walp. 4,000-6,000 feet.
" micrantha (Thunb) R.Br. 5,000 feet.

Umbelliferae.

Aciphylla glacialis F.v.M. 5,500 feet - summit.
" simplicifolia F.v.M. 5,500 feet - summit.
Azorella cuneifolia F.v.M. 5,500 feet - summit.
" dichopetala Benth. 5,500 feet - summit.
" Muelleri Benth. 5,500 feet - summit.
Diplaspis hydrocotylea Hook. 5,500 feet - summit.
Hydrocotyle hirta R.Br. 5,500 feet - summit.
Oreomyrrhis andicola Endl. 4,000-5,000 feet.
" pulvinifica F.v.M. 5,500 feet - summit.
Seseli algens F.v.M. 5,500 feet - summit.

Guttiferae.

Hypericum japonicum Thunb. 4,000-5,500 feet.

Epacridaceae.

Acrotriche serrulata R.Br. 4,000-5,500 feet.
Brachyloma daphnoides Benth 4,000-5,500 feet.
Epacris heteronema Labill. 4,000-5,500 feet. (No specimens on record)
" microphylla R.Br. 5,500 feet - summit.
" mucronulata R.Br. 5,500 feet - summit.
" paludosa R.Br. 4,000-5,500 feet.
" petrophila Hook 5,500 feet - summit.
" serpyllifolia R.Br. 4,000 feet - summit.
Leucopogon glacialis Lindl. 5,500 feet - summit.
" Hookeri, Sond. 4,000 feet - summit.
" juniperinus R.Br. 4,000-5,500 feet.
Lissanthe montana, R.Br. 4,000 feet - summit.
Monotoca elliptica R.Br. - 5,500 feet - summit.
Richea Gunnii, Hook. f. 4,000 feet - summit.
Trochocarpa pumila, R.Br. 5,500 feet - summit.

Gentianaceae.

Gentiana montana Forst. 5,500 feet - summit.

Convolvulaceae.

Convolvulus sepium Linn. 4,000-5,500 feet.

Labiatae.

Ajuga australis R.Br. 4,000 feet.

Prostanthera/...

Labiatae (continued).

Prostanthera cuneata Benth. 4,000 feet - summit.
" linearis R.Br. 4,000 feet.
" rotundifolia R.Br. 6,500 feet - summit.
Brunella vulgaris D.C. 4,000-6,000 feet.

Borraginaceae.

Myosotis australis R.Br. 4,000 feet - summit.

Scrophulariaceae.

Euphrasia antarctica Benth. 5,500 feet - summit.
" Brownii F.v.M. 5,500 feet - summit.
" collina R.Br. 5,500 feet - summit.
" speciosa R.Br. 5,500 feet - summit.
Veronica Derwentia Littlej. 4,000 feet - summit.
" densifolia F.v.M. 5,500 feet - summit.
" nivea Lindl. 5,500 feet - summit.
" perfoliata R.Br. 4,500 feet.

Lentibulariaceae.

Utricularia dichotoma Labill. 5,500 feet - summit.

Plantaginaceae.

Plantago Brownii Ref. 5,500' - summit.
" Gunnii Hook. 5,500 feet - summit.
" varia R.Br. 4,000 feet - summit.

Rubiaceae.

Asperula oligantha F.v.M. 4,000 feet - summit.
Coprosma hirtella Labill. 4,500 feet.
" pumila Hook f. 5,500 feet - summit.
Nertera depressa Banks. 5,500 feet - summit.

Campanulaceae.

Lobelia pedunculata R.Br. 4,000 feet.
" purpurascens R.Br. 4,000-5,500 feet.
Wahlenbergia gracilis A.D.C. 4,000 feet - summit.

Goodeniaceae.

Goodenia hederacea Sm. 5,000 feet - summit.
Scaevola Hookeri F.v.M. 5,500 feet - summit.
Velleia paradoxa R.Br. 4,000 feet - 5,500 feet.

Candolleaceae.

Stylidium graminifolium Swartz. 4,000 feet - summit.

Compositae.

Abrotanella nivigena F.v.M. 6,000 feet - summit.
Antennaria uniceps F.v.M. 6,000feet - summit.
Brachycome ciliaris Less. 4,000-5,500 feet.
" cardiocarpa F.v.M. 4,000-5,500 feet.
" calocarpa F.v.M. 4,000-5,500 feet.
" decipiens Hook. 5,500 feet - summit.
" nivalis F.v.M. 5,500 feet - summit.
" radicans Steetz. 5,500 feet - summit.
" scapiformis D.C. 4,000-5,500 feet.

Brachycome/...

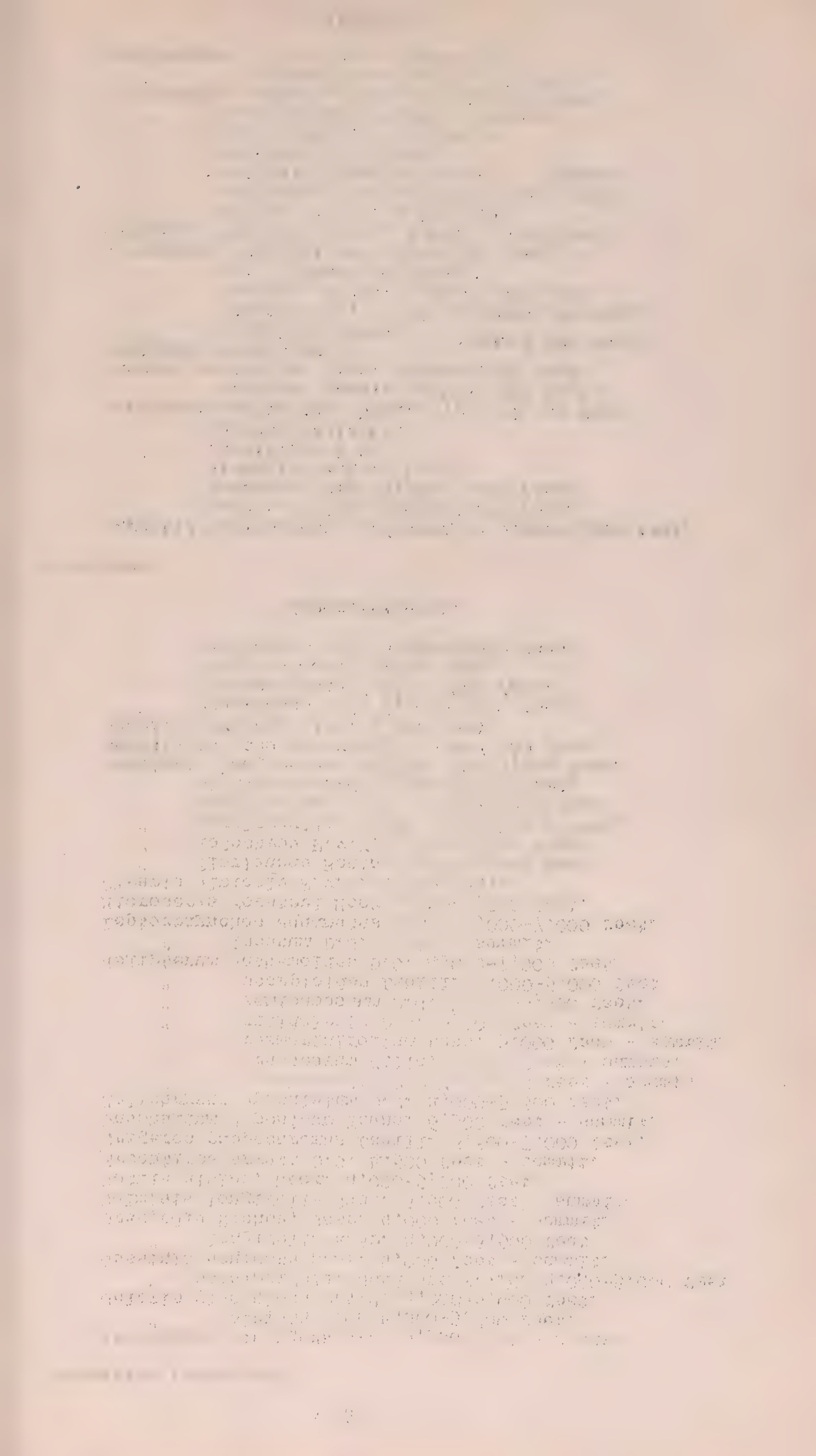
Compositae (continued).

Brachycome scapigera D.C. 5,500 feet - summit.
" stricta D.C. 4,000-5,500 feet.
Calotis glandulosa F.v.M. 4,000-5,500 feet.
" scabiosifolia Sond and F.v.M. 4,000-5,000 feet
Cassinia aculeata R.Br. 4,000 feet - summit.
" longifolia R.Br. 4,000-5,500 feet.
Craspedia Richea, Cass. 4,000 feet - summit.
Celmisia longifolia Cass. 5,500 feet - summit.
Cotula alpina, Hook. 4,000-5,000 feet.
Erechtites arguta D.C. 4,500 feet - summit.
Erigeron pappochromus Labill. 5,500-7,000 feet.
Gnaphalium japonicum Thunb. 6,500 feet - summit.
Helichrysum apiculatum D.C. 4,000-5,500 feet.
" baccharoides F.v.M. 4,000 feet - summit.
" bracteatum Willd. 5,500 feet - summit.
" rosmarinifolium Less. 5,000 feet - summit.
" rutidolepis D.C. 5,500 feet - summit.
" semipapposum D.C. 4,000-5,500 feet.
" scorpioides Labill. 4,000-5,000 feet.
Helipterum anthemoides D.C. 4,000-7,000 feet.
" incanum D.C. 5,500 - summit.
Leptorrhynchos squamatus Less. 5,000-7,000 feet.
Microseris Forsteri Hook 4,000-5,500 feet.
Olearia alpicola F.v.M. 4,500 feet.
" floribunda Benth. 4,000-7,000 feet.
" iodochroa F.v.M. 4,000-5,500 feet.
" megalophylla F.v.M. 4,000-5,500 feet.
" myrsinoides F.v.M. 4,000-5,500 feet.
" stellulata D.C. 4,000-7,000 feet.
Podolepis longipedata A.Cunn. 500-7,000 feet.
Ewartia catipes Beauverd. 5,500-7,000 feet.
Senecio dryadeus Rich. 5,500 feet.
" Georgianus D.C. 5,500-7,000 feet.
" lautus Soland 3,000-7,000 feet.
" odoratus Horn. 4,000 feet.
" pectinatus D.C. 5,500-7,000 feet.

Monocotyledons.

Gramineae.

Agrostis Muelleriana, J.Vickery - 5,000-7,000 feet.
" scabra, Willd. 5,000-7,000 feet.
" venusta, Trin. 5,500-7,000 feet.
" hiemalis (Walt.) B.S.P.
" parviflora R.Br.
" australiensis Mez.
Agropyrum pectinatum, Beauv. 4,000-7,000 feet.
" scabrum, Beauv. 4,000-7,000 feet.
Themeda australis, Linn. 4,000-5,500 feet.
Danthonia nuda Hook.f. } 5,500-7,000 feet.
" nudiflora Morris. }
" penicillata, F.V.M. 4,000-6,000 feet.
" robusta, F.V.M. 5,500-7,000 feet.
" spp. 5,500-7,000 feet.
Deschampsia caespitosa 3,000-7,000 feet.
Deyeuxia Gunniana (Nees), Benth. 4,000 feet.
" frigida, F.V.M. 5,500 feet.
" quadriseta, Benth. 4,000-7,000 feet.
" monticola (Roem & Schult) J. Vickery.
" carinata, J. Vickery.
" crassiuscula, J. Vickery.
" brachyathera (Stapf) J.Vickery.
Dichelachne crinata, Hook. 4,000-5,500 feet.
" sciurea Hook. 4,000-5,500 feet.
Echinopogon ovatus Palis. 4,000 feet.



Gramineae (continued).

Vulpia bromoides (Linn) S.F. Gray 4,000 feet.
Hemarthria compressa R.Br. 3,000-4,500 feet.
Hierochloe redolens R.Br. 5,500 feet.
Panicum effusum R.Br. 4,000 feet.
Enneapogon sp. 4,000 feet.
Poa caespitosa Forst. 4,000-7,000 feet.
Festuca Muelleri J. Vickery 5,500-7,000 feet.
Stipa pubescens, R.Br. 5,500-7,000 feet.
Trisetum subspicatum Palis 4,000-7,000 feet.

Cyperaceae.

Carex Buxbaumii, Wahl. 5,500 feet - summit.
" breviculmis, R.Br. 5,500 feet - summit.
" caespitosa, Linn. 4,000 feet - summit.
" canescens, Linn. 5,500 feet - summit.
" cephalotes, F.v.M. 5,500 feet - summit.
" declinata, Boott. 4,000 feet - summit.
" echinata, Murr. 5,500 feet - summit.
" hypandra, F.v.M. 5,500 feet - summit.
" vulgaris, Fries. 5,500 feet - summit.
Carpha alpina, R.Br. 4,000 feet - summit.
Lipocarpha microcephalum Kunth. 5,500 feet - summit.
Oreobolus pumilio, R.Br. 5,500 feet - summit.
Schoenus apogon, Roem et Schult. 4,500-6,000 feet.
Scirpus Crassiusculus, Hook. 5,500 feet - summit.
" cartilagineus, Spreng. 5,500 feet - summit.
" riparius, Spreng. 5,500 feet - summit.
" setaceus, Linn. 4,500 feet - summit.

Restionaceae.

Hypolaena lateriflora, Benth, 5,500 feet - summit.
Restio australis, R.Br. 5,500 feet - summit.

Juncaceae.

Juncus pallidus, R.Br. 4,500 feet.
" falcatus, E.Mey. 4,500 feet - summit.
" planifolius, R.Br. 4,000-5,500 feet.
" prismatocarpus, R.Br. 4,000-5,500 feet.
Luzula campestris, D.C. 4,500 feet - summit.

Liliaceae.

Arthropodium paniculatum R.Br. 4,000-5,000 feet.
Astelia alpina R.Br. 6,500-7,500 feet.
Bulbine bulbosa Haw. 4,000-5,500 feet
Dianella tasmanica Hook f. 4,000 feet - summit.
Lomandra longifolia, R.Br. 4,500-5,500 feet.
Lomandra species, below 4,000 feet.

Amaryllidaceae.

Hypoxis hygrometrica Labill. 4,500 feet.

Orchidaceae.

Diuris pedunculata R.Br. 4,500-6,000 feet.
Microtis parviflora Spreng. 4,500 feet.
Prasophyllum alpinum R.Br. 5,500 feet - summit.
" Suttonii R.Br. 5,500 feet - summit.
Pterostylis mutica R.Br. 4,500-5,500 feet.
Thelymitra venosa R.Br. 5,500 feet.
Prasophyllum Frenchii F.Muell.

Pterostylis/...

Orchidaceae. (continued)

Pterostylis falcata Rogers.
Caladenia Lyallii Hook. f.
Chiloglottis Gunnii Lol.
Pterostylis alpina Rogers.
" coccinea Fitzg.
Gastrodia sesamoides R.Br.

Caladenia alpina. Rogers was recorded there in 1927; but since then it has proved to be identical with the N.Z. C. Lyallii Hook. f.

Pteridophyta.

Lycopodiaceae.

Lycopodium clavatum L. var. fastigiatum Benth. 6,000 feet - summit.
Lycopodium varium R.Br. 6,000 feet - summit.

Filicales.

Gleichenia sp. 4,000-5,500 feet.
Hymenophyllum cupressiforme Labill. 5,500 feet - summit
Asplenium trichomanes L. 4,000-5,500 feet.
Asplenium flabellifolium Cav. 6,000 feet - summit.
Polystichum aculeatum (L.) Roth 5,500 feet - summit.
Cheilanthes tenuifolia (Burm.) Sw. 4,000 feet - 5,500'
Pleurosorus rutifolius (R.Br.) Fee 4,000-5,500 feet.
Blechnum capense (L.) Schlecht. 4,000-5,500 feet.
" penna-marina (Poir.) Kuhn 4,500 feet - summit
Lindsaya cuneata (Forst.) C.Chr. 4,000-5,500 feet.
Polypodium Billardieri (Willd.) C.Chr. 5,500 feet -summit.
Pteridium aquilinum (L.) Kuhn var. 4,000-5,500 feet.
esculentum (Forst.) Kuhn.
Cytopteris fragilis (L.) Bernh. var. laetiverens (Prent.) C.Chr. 6,000 feet - summit.

Gymnosperms.

Podocarpus alpina R.Br. 4,500 feet - summit.

This brief account of the botany of the area indicates that the Park area is exceptional in the wide range of plant communities that are found there and in the richness of the flora. In fact the diversity is remarkable and not excelled by any area in Australia.

BOTANICAL VALUE OF AREA.

There are many reasons why the Kosciusko area is important to the botanist.

No other locality in Australia carries such a variety of plant communities. It is possible to examine dry sclerophyll forests, wet sclerophyll forests, forest swamps, grasslands, river communities, sub-alpine and alpine vegetation in an area of a few hundred square miles. An aggregation such as this is exceptional in Australia, where it is usual to find such areas covered by a single type of community.

It contains examples unequalled in Australia and few better in the world of the control of plant communities by climate and presents an exceptional opportunity for

studying this relationship.

The area contains a wide range of species. This is to be expected from the diversity of the plant communities in the district. Each community has its own characteristic plants. Plants restricted to the dry sclerophyll forests are found within easy distance of those restricted to alpine conditions. This feature makes the area floristically the richest of its size in Australia and a collector's Mecca.

In addition to this wealth of species, the percentage of rare and uncommon plants is high. Alpine plants are not common in Australia because of the absence of suitable habitats. Many of these are of outstanding botanical interest because of their close affinities with the flora of Tasmania and the sub-antarctic floral element.

The sub-alpine and alpine communities are rare in Australia. Kosciusko is the outstanding example and is ideal for the study of this little understood flora.

Sphagnum bogs and alpine swamps found in the area are some of the best in Australia. They are large and well formed. Botanically they have not been studied. Their formation, age and structure present an interesting problem.

The wide range of climate and habitat presents an opportunity (not found elsewhere) to examine the variations in plant form in relation to environment. Many of the species have an altitude range of four thousand feet and associated with this are curious morphological changes. Morphology is partly the basis for classification and a study of variation in relation to climate would be invaluable to the systematist.

Further the plants of the area are of considerable value to the comparative morphologist and physiologist. These species are either related to the endemic Australian element or the sub-antarctic floral element and both have adapted themselves to similar conditions. The Australian sclerophyte has competed successfully with the sub-antarctic in the alpine zone and the converse is true in the sclerophyll zone. No other area of Australia offers these features.

Very special forms of adaptation are seen in the plants of the bogs and wind-swept tops. In the bogs the root system is permanently water-logged and the aerial system exposed to desiccating winds. Such adaptations are uncommon elsewhere in Australia.

Botanically the area is unique in Australia and it is not an exaggeration to say one of our outstanding scientific assets.

THE STATE OF THE VEGETATION.

In the descriptions of the plant communities little attention was given to the condition of vegetation beyond pointing out that fire damage etc. occurred. At this stage it is worth while examining this matter more closely, especially to see if the vegetation has undergone any undesirable changes since settlement took place.

Evidence for making a comparison between the former (say 50 years ago) condition of the vegetation and the present has been obtained from conversation with local

people, from previous descriptions, and observations made during the survey.

It is important to realise that the present interests in the Kosciusko area are not concerned with the preservation of natural vegetation. Natural vegetation is not an asset, but a liability which must be removed to improve the country for grazing. Snow gum, shrub lands and swamp are considered useless, and efforts have been made to destroy these communities in an endeavour to increase the snow grass pasture.

The policy has been (and still is) to deliberately burn off large tracts of country to kill out tree and shrub cover to permit the spread of the snow grass, any regeneration being prevented by overgrazing. There is general agreement that considerable success has been achieved in this respect, and that much of the snow gum and shrub land has been opened up for pasture. There is no doubt that the shocking condition of much of the area is due to this attitude.

Maiden's account is not particularly useful because it gives no quantitative information on the density of species. Consequently, it is difficult to say whether any species previously common in the district has now disappeared. In addition, time did not permit us to make observations on the rarity of species as the party visited the area for a limited period only. However, at least 80% of the species reported by Maiden were recorded. As indicated it is impossible to state whether species listed by Maiden and not collected by the survey party are now missing from the district. But it would be surprising indeed, if such were not a fact, because of the devastating changes which have taken place in the communities over the years.

Maiden mentions shrub land, grass lands, snow gum, bog and swamp areas, but does not describe the plant communities.

McLuckie and Petrie described the alpine and subalpine plant communities. The three vegetation units recognised correspond with observations made during the survey and also fit in with Maiden's vague descriptions. This suggests that the original units of the vegetation were snow gum forest, shrub lands, grass sward and swamp.

It is not possible to conclude definitely from Maiden or McLuckie and Petrie's descriptions, whether there have been changes over the years, as they collected descriptive not quantitive data for a locality. But indirect evidence strongly suggests that serious degeneration has occurred even since 1927.

McLuckie and Petrie determined the seral relationships between the various communities, that is, the position of equilibrium in a community adapted to its environment. Our observations, particularly on the swamps, do not coincide with theirs. This is due to changes in the communities or to the lack of data collected on the recent trip. The latter possibility is unlikely.

The swamp communities are much telescoped and many species from the drier zones like snow grass and Hypolaena are invading the swamps. Such species do not grow if permanent water is present. This suggests that the water table has fallen and that the swamps examined are drying up. Further evidence of this is seen in the patches of dead swamp separated from the main swamp by snow grass, etc. The swamp has retreated leaving behind the isolated pockets.

Most swamps/..

Most swamps are badly damaged by stock. The continuous grazing, the pounding of the swamp surface and damage by fire are responsible for the disorganised and telescoped structure of the communities. Further, as the result of excessive soil-erosion on the slopes, the soil gradually collects on the swamp and kills out the swamp communities.

These observations strongly suggest that the swamp communities have suffered badly. Even in the short period since 1927 considerable changes have taken place.

McLuckie and Petrie and others have commented on the damage done by fire and the absence of regeneration in the burnt-out areas. Unfortunately, there is ample proof of this in the sub-alpine zone.

As pointed out in the general discussion of the plant communities, it is impossible to find virgin areas of snow gum forest. But by piecing together fragments from different spots, a moderately accurate picture can be obtained. A virgin forest is a closed community with interlocking branches, a shrub stratum beneath and a discontinuous herbaceous stratum below the shrubs (Figure 11). Usually the shrub layer is not as conspicuous towards the tree line, but the canopy is still closed and the grass stratum better developed (Figure 12).

Most areas of snow gum do not show this structure. Degeneration is common. In some areas it is complete, in others partial. Degeneration commences with the opening up of the canopy by the death of some of the dominant trees. This is followed by the gradual breaking up of the shrub layer, and the spreading of the snow grass between the shrubs. Finally the tree and shrub layer disappears and the area is completely colonised by snow grass. If degeneration proceeds beyond this state, the soil is eroded from between the snow grass tussocks until a bare subsoil surface is formed.

Incomplete degeneration is widespread. It is seen at Hotel, Chalet, Dead Horse Hut, White's River Hut and other areas. e.g. Figure 13.

More advanced stages of degeneration are common. Hotel, Pretty Point, Dead Horse Hut etc. The trees are ruined, shrubs missing and grass invasion complete. (Figure 14).

This condition is desired by snow lease holders as it means increased pasture grasses.

If regeneration is prevented, damage to the community continues until a bare soil surface is reached. This has occurred in some areas.

Soil eroded from such areas is silting up the swamp areas, thus assisting in their destruction.

McLuckie and Petrie do not comment on the state of the snow grass association. Since much of their work was carried out around Mt. Stilwell, Blue Lake etc., this is surprising. If erosion were evident at that time, it could hardly have escaped their notice. This suggests that the shocking condition of the snow grass communities in that area has developed over the last fifteen years.

It is clear from the above discussion that all units of the vegetation of the plateau have undergone serious

degeneration over the years. In fact, it is impossible to find any that approximates to the original state. That this is the result of the treatment the country has received in the past is obvious. Bushfires and overgrazing have been responsible. The end-product of the degeneration of vegetation is soil-erosion, and the amount of erosion may be taken as a measure of the destruction of a plant community.

SOIL-EROSION.

Much has been said about soil-erosion in Australia, and the dangers are realised by most people. Therefore, it is not intended to discuss that aspect, but simply to record the extent.

The soils of the plateau are derived from granites and slates. Both rocks under the prevailing climate give rise to porous, oaken soils which are very susceptible to erosion, if the vegetation cover is removed.

Erosion is common throughout most of the park - at the Hotel, Pretty Point, the Chalet, Mt. Tate, Blue Lake, Dead Horse Hut, etc.

Above the tree-line overgrazing is the only factor responsible for the destruction of the plant cover. Sheep eat out established plants and prevent regeneration of young ones. This leads to a decrease in the density of plant cover and to the commencement of erosion. This is seen at its worst around the Blue Lake. The soil is dissected with channels and gutters up to four feet deep (Figures 15 and 43).

Fortunately, the seriousness of the situation is realised (as far as this area is concerned) as it is now closed from stock to permit regeneration. Observations on regeneration, if collected, in this area, should yield useful information for the management of the rest of the Park.

Much of the country above the tree-line shows signs of soil-erosion, but not to the extent of the zone around the Blue Lake. If, as appears likely, the erosion around Blue Lake has developed to such an extent in the past fifteen years, the widespread incipient erosion, throughout the rest of the alpine zone, is a matter of serious concern. Vegetation in an alpine environment has a precarious existence at the best of times; but it is a hopeless competition when the environment is made doubly difficult by overgrazing. If sheep are allowed to remain in this zone, it is probable that much of the country will be eroded to the same degree as the Blue Lake area.

Erosion is equally common in the sub-alpine zone. Bushfires have killed hundreds of acres of snow gums, and, regeneration, which is a slow process in such a climate, has been prevented by overgrazing. The combined effect of fire and sheep has ruined much of the country around the Hotel, Pretty Point, Dead Horse Hut, etc. (cf. Figure 16).

It is obvious from what has been said that marked changes have taken place since colonization. These may be summarised as follows :-

(1) No virgin country in the plateau.
(2) Elimination of some species.
(3) A decrease in the area covered by snow gum and shrubs.
(4) A decrease in the area covered by bog and swamp.

(5)/...

(5) An increase in the area under snow grass.
(6) A decrease in the density of all communities.
(7) Considerable erosion in all communities.

It is also apparent that these changes are the result of bushfires and overgrazing, and whether this is allowed to continue will depend upon the future development of the Park.

FUTURE DEVELOPMENT.

There are three things to be considered in assessing the value of the Kosciusko Vegetation. Firstly, the possibilities of a tourist trade, secondly its scientific value, thirdly its value to the Pastoral Industry. The future use of the district should be determined by the importance attached to these interests. The first two are dependent on each other; the latter is diametrically opposed.

At first glance, the first two may appear to have little in common, as one is concerned with vegetation as a part of the scenery and the other with plants as scientific specimens. However, they are related, since both depend upon the preservation of the vegetation cover.

A successful tourist trade depends, other things being equal, on the scenery of a district. A country covered with trees and shrubs is far more attractive than one defaced by erosion and scarred by bushfires. It matters little what artificial attractions are presented, like golf courses and bridle tracks, if these are set between dead trees and over bare earth.

It should be possible to build up a very flourishing tourist trade in the area as the scenery is magnificent. The wide range of plant communities and the richness of the vegetation form an area in which an overseas tourist could obtain a very clear picture of Australia in a short time. There would be no need to travel hundreds of miles to see how the Australian bush looks, for telescoped into a small zone is found almost every type of community, with the exception of arid and tropical vegetation, which Australia has to offer (cf. photos of vegetation).

It is not our intention to examine the economic advantages of a flourishing tourist trade. But surely it would be a very poor one if it could not return an income equal to that derived from the snow leases. The success of this trade will depend largely upon the protection and management of the vegetation and the National Park.

Enough has been said about the botanical features of the Park to show that it is one of the best scientific assets in Australia. The rare species, the floral elements, the range of communities, the curious adaptations and the remarkable variations indicate its outstanding botanical importance. Many of these features are limited to Kosciusko and this scarcity makes it even more imperative that the vegetation should be protected.

Water-conservation and soil-erosion are further problems which depend upon the treatment received by the vegetation and both are accentuated by the degeneration of the plant cover.

The pastoral industry requires grasslands for feeding stock. The Park has excellent natural pastures which

are valuable/...

are valuable for summer grazing. The area is, therefore, of economic importance to graziers. In the past, the aim of industry has been to increase the snow grass pastures by destroying the rest of the vegetation. The results are well known and have been outlined. Much of the country is in a shocking condition, the vegetation is partly ruined, soil-erosion common and water-catchment impaired.

The use of the country for grazing is incompatible with conservation and a tourist trade. The question is whether the economic value of the pastures is to be considered greater than its scientific and potential tourist value. It is impossible to have, on the one hand, a pastoralist industry that persists in a policy of overstocking and burning off - which destroys the vegetation, leads to soil-erosion and ruins catchment areas - and at the same time to maintain a vegetation which appeals to the tourist and preserves things of scientific interest.

As yet no constructive efforts have been made to preserve the vegetation. It is incongruous to have a National Park that is nothing more than a sheep run. The area of the Park is an insignificant part of the area of New South Wales, and it is not exorbitant to suggest that it be closed permanently from stock to permit regeneration and to preserve the present vegetation. If this be done and a tourist trade established, the income lost from snow leases would be more than offset.

Even assuming that tourist trade and the conservation of natural phenomena are considered less important than the shepherds, then, it is still imperative to withdraw much of the country from grazing to prevent its being ruined permanently. The carrying capacity of the grasslands is falling away slowly and will continue to do so if positive steps are not taken to control soil-erosion and degeneration of plant cover.

Whether sheep or tourists are to provide the income for the National Park it is obvious that certain areas must be withdrawn from stock.

PRIMITIVE AREA.

Complete preservation of the vegetation is desirable, and a large section of the country should be set aside as a primitive area. If this is to remain a primitive area, most tourists and sheep should be prevented from using it. Roads should not be made through the primitive area as inconsiderate tourists can do as much damage as sheep. The prevention of tourists from using the primitive area would not be serious, as they would have the use of the rest of the Park.

The area outlined on the map is suggested as a suitable site. It contains examples of all the botanical features that are to be found in the National Park area.

The Tin Mine Hut Area has been suggested as a suitable site for a primitive area. In our opinion, this area is not so suitable as the one suggested by us. Ecologically and floristically it is limited in value, as practically the whole of the area is covered by a single plant community. It does not approach the other area in diversity of associations and richness of species; however if the Park is withdrawn from grazing and re-established as a Park, this area will largely be preserved.

The Natural History Survey carried cut reconnaissance work only, and before a detailed account of the vegetation etc. can be prepared, further work is necessary. If it considered that a National Park is to be established then certain things should be done in the near future.

The Park area should be closed permanently from grazing. This would permit the regeneration of much of the country, and, at the same time, tend to eliminate the other serious problem - fire. (This step is necessary whether grazing is permitted or not, for much of the country is rapidly deteriorating).

The successful treatment and maintenance of the vegetation are problems for an ecologist. It is essential whether the Park remains a sheep-run or becomes a National Park, for an ecologist to be appointed as a consultant to the Park Trust to advise on soil-erosion, etc. A better scheme would be the appointment of a full-time ecologist as manager of the Park.

The ecologist should have a staff of Park rangers for maintenance and fire-fighting etc., and a proper fire-fighting organization established.

Research should be initiated immediately on the regeneration process. Such information would be invaluable in the maintenance of the vegetation.

The Blue Lake area has been fenced for three years, but no quantitative data have been collected on the rate of recovery, density of species, etc. in that time. A party should visit the area each year to collect this information.

Additional information should be obtained so that an account of the ecology of the area could be written. This should include an ecological map and explanatory notes. Along with the ecology, a local flora of the actual species should be compiled. These accounts could be written in a semi-technical way, so that the layman could use them. Before such is possible, further data are necessary, and it is suggested that next year a party should be sent to collect the necessary information.

Since the control of the vegetation depends upon a proper understanding of rates of regeneration, growth, reproduction, etc., and as no information of this type is available, research should be commenced immediately to obtain such data.

The information required for the above suggestions is of three types :-

(a) Detailed collecting for the local flora.

(b) Detailed observation on regeneration.

(c) General observations on the distribution of communities.

This means that the party should consist of two parts, one which continues the reconnaissance survey through areas not yet visited and the other which spends longer time-periods collecting in selected sites.

The management of the Park should be directed by a

Trust/...

Trust which includes biologists, and its policy should be one of preservation, not exploitation. No effort should be made to encourage tourists and open up the tops for such a trade until the necessary organization is in existence.

The Park should have a forester ecologist in charge and a staff of rangers - similar to the American National Parks.

SUMMARY.

(1) A brief account of the vegetation of the Park shows that serious degeneration and soil-erosion have occurred as the result of bushfires and overgrazing. If these are permitted to continue, the complete disorganization of the natural plant communities will occur.

(2) This is unfortunate, as the vegetation is unique in Australia, and all efforts should be made to preserve it.

(3) The country itself has magnificent scenery and climate and could support a flourishing tourist trade.

(4) Preservation of the vegetation and a tourist trade are incompatible with sheep, and if the Park is to become a reserve it should be closed indefinitely from grazing.

(5) An ecologist should be appointed Director of the Park.

(6) If this is not possible, an ecologist should be obtained as consultant to the Trust.

(7) Immediate research should be commenced on the study of regeneration and erosion. A party should visit the area each year to obtain information on this process. (This would not be necessary if an ecologist is appointed).

(8) Steps should be taken to complete the reconnaissance survey for an ecological map.

(9) Steps should be taken to collect and complete a local flora.

(10) Park rangers should be appointed for maintenance and fire-fighting.

(11) Considerable discretion should be shown in opening up the country with roads, etc.

(12) A primitive area should be established which is completely closed from tourists and grazing.

(13) The Park Trust should include biologists.

(14) The Park policy should be one of preservation and not exploitation. The American National Parks could be taken as models in this respect.

IV. REPORT ON THE MAMMALS.

The fact that very few mammals were observed during the preliminary scientific survey was not due to hurried movement and brief encampments imposed by an extensive itinerary, but is actually indicative of the drastic deterioration of the flora which has resulted from the systematic, casual, and occasionally accidental, burning-off of the bush and herbage. Evidently, systematic firing of flora, with resultant denudation and soil-erosion, has become the accepted corollary of permissive occupancy and stock-grazing throughout the Kosciusko area. This fact was not only self-evident in the state of the country, but was also manifest in the attitude of those concerned with the commercial exploitation, as opposed to the recreational aspect, of the State Park.

Definite evidence of this attitude was provided in the advisory report of an expert survey committee, exclusive of a biologist, which actually recommended that the burning-off process, conditional with the grazing leases, would really favour the fauna by ensuring an abundance of succulent herbage! Apart from considerations of flora and erosion, however, this view is discounted fundamentally by the age-old survival of a representative mammalian fauna in the Mt. Kosciusko region, as contrasted with its rapid deterioration in both species and population during the past fifty years.

There can be no question of the biological fact that continued firing of forest growth has eliminated the larger mammals, such as kangaroos and wallabies, from most of their upland haunts. Burning of herbage has also destroyed countless small insectivorous marsupials, as well as the nests and eggs of useful birds. The resulting restriction of habitat, and drastic disturbance of nature's balance, may be shown by the rapid increase in case-moth destruction of large areas of grass.

Leasing of almost the entire State Park zone for grazing, with the right of firing and cutting timber, is entirely contrary to the organization of the great National Parks of the United States, in which extra stock, such as the Bison, would be tolerated only for the conservation of rare or vanishing species. In America, furthermore, where the relationship between predatory and other mammals is far more naturally balanced, despite bears, large cats, coyotes, and wolves, fire is definitely regarded as the main menace to the preservation of both forest and fauna. As in Yosemite National Park, therefore, there is a comprehensive fire-fighting organization, with observation towers equipped for pin-pointing outbreaks, and an instrument to indicate the danger-mark of aridity, which dictates a state of alertness for completely equipped fire-fighting squads. An aeroplane may be employed for "spotting" and directing operations in special emergencies, and it is found that the tourist revenue from the sustained attraction of forest and fauna more than compensates for such services of national conservation.

The mammalian balance in Australia is far more delicately adjusted than in any other part of the world, because prolonged isolation evolved mostly harmless slow-breeding marsupials which are particularly susceptible to the inroads of settlement, and the destructive effects of fire and introduced predatores. It is most significant that the largest marsupial predatore, the Tasmanian pouched-wolf or thylacine, was probably banished from the mainland following upon introduction of the dingo by natives. Subsequently, the whites

imported/...

imported the greatest of all faunal menaces, the fox, now more plentiful than the dingo about Mt.Kosciusko. It is surely evident from the foregoing that a firm conservational policy, with early delimitation of primitive areas and trail-ways, prohibition of uncontrolled firing of the bush, and control of foxes and wild dogs, is absolutely essential to the regeneration of the Kosciusko State Park both as a national sanctuary and an educational resort for tourists.

List of recorded mammalian fauna.

In the absence of detailed records, the following list has been compiled from scattered records, specimens in the Australian Museum, and from field observations, for which acknowledgment is due mainly to Mr. A.S. Le Souef.

PLATYPUS (Ornithorhynchus anatinus): Probably well distributed along less rocky streams of lower levels. Unconfirmed reports of platypus appearing in the Hotel lake may refer to strays from Diggers Creek; suggests possibility of exhibition as at Healesville Sanctuary.

SPINY ANT-EATER (Tachyglossus aculeatus): Sparsely distributed throughout the area. Specimen obtained at about 5,000 feet; above the Hotel.

GREAT GREY KANGAROO (Macropus major): Once generally distributed up to 5000 feet, in small mobs of from 5 to 8. Now missing over large areas. Only observed by the party about the flats of Diggers and Sawpit creeks, near Tom Grogin, and along the track from Tin Mine to Freebody's Hut.

WALLAROO (Osphranter robustus): Reported by Le Souef as being found on the slaty hills about the head of the Jacobs River, and around Yarrangobilly. Possibly, in rough country below the Hotel.

RED-NECKED BRUSH-WALLABY (Wallabia rufogrisea): A once plentiful Monaro species, now seen rarely in the undergrowth of the Snowy River valley.

SWAMP OR BLACK-TAILED BRUSH-WALLABY (Wallabia bicolor): Now sparsely distributed in the undergrowth of the Snowy valley. Single ones occasionally seen, but not by party.

ROCK-WALLABY (Petrogale penicillata): Reported as occurring in isolated small colonies on the rocky spurs of the Snowy River valley, on each side of the junction with Diggers Creek. This wallaby, as at Jenolan, is especially suitable for conservation as a tourist attraction, while being extremely susceptible to the activities of foxes.

GREY BRUSH-TAIL POSSUM (Trichosurus vulpecula): Inhabits suitable eucalypt country, to about 5000 feet; not seen by party.

BLACK BRUSH-TAIL POSSUM (Trichosurus caninus?): Reported from the Mountain Ash country in the vicinity of the Thredbo River, on the Leather Barrel ridges, and along the track from Grogin to Deadhorse Hut.

RING-TAIL POSSUM (Pseudocheirus laniginosus): Reported as fairly common in "Tea-Tree" scrubs along the creeks. Probably in Banksia scrubs approaching Leather-Barrell. Collected at 5000 feet, for Harvard Museum.

GREATER GLIDER-POSSUM (Schoinobates volans): The large black and white variety has been reported from the Kosciusko area, probably in the Mountain Ash forests. A Museum specimen is from Geehi Gorge.

SUGAR GLIDER-POSSUM (Petaurus breviceps): Reported from forests of the lower ranges; actual distribution not known. Probably plentiful in Banksia brushes, east of Snowy Creek on approach to Leather-Barrel.

PIGMY OR DORMOUSE POSSUM (Cercartetus concinnus): Probably throughout brush and forest country, especially Banksia brushes along track from Snowy Creek to Leather-Barrel. Museum specimen from Grosses Plain.

KOALA (Phascolarctos cinereus): Well-known in the vicinity of the Thredbo River about 40 years ago but apparently not there now. More recently reported from near Sawpit Creek, south of the road. Could be re-established as suitable eucalypts are present. Appropriate areas could be selected and fence-proofed against departure of koalas, as at Healesville Sanctuary, thus aiding restoration of the species and providing a special attraction for tourists.

WOMBAT (Vombatus hirsutus): Generally distributed throughout the better type of country to about 5000 feet. Burrows were observed, evidently occupied, at Geehi, Grogin, and higher altitudes such as Cascade Hut, where some remains suggested that the dingo and fox may have a limiting effect on numbers. Suitable for display in a nature park.

BANDICOOT (Perameles nasuta): Not seen, or recently reported. Possibly eliminated by fox. Specimen in Museum from Buckley's Crossing.

MARSUPIAL OR NATIVE CAT (Dasyurus quoll): Reported as being seen in vicinity of the Hotel. Its larger relative, the "Tiger Cat" (Dasyurops maculatus) doubtless also inhabits the forest country of all lower levels. Useful destroyer of rabbits, rats, and some large insects, but preys on small marsupials and birds. Native predatores.

MARSUPIAL-MICE: Swainson's Pouched-mouse (Antechinus swainsonii) was collected at White's River Hut, and is in Museum from about 6,000 feet (probably Chalet), and from Kiandra. The smaller Yellow-footed species (Antechinus flavipes) is from Tine Mine, and various localities. Useful consumers of grasshoppers and other insects and their larvae, marsupial-mice as log and tree-dwellers are most endangered by fires.

Rodents.

COMMON NATIVE OR ALLIED RAT (Rattus assimilis): This greyish-brown and soft-furred native rat is probably the commonest mammal about Mt. Kosciusko. It was trapped at White's River Hut, the Chalet, Geehi, Grogin. Museum specimens from near the Hotel and the Creel were received from Mr. Le Souef. The introduced Rattus rattus does not appear to have become established at the higher altitudes.

SWAMP RAT (Rattus lutreolus): Reported by Le Souef as inhabiting Diggers Creek; no Museum specimens to indicate general distribution.

BROAD-TOOTHED RAT/...

BROAD-TOOTHED RAT (Mastacomys fuscus): Trapping of specimen at White's River Hut provided most striking mammal record of the Survey, as extending the range of the remarkable indigenous rat from the Otway region of Victoria. Identity of an immature specimen collected by Le Souef in 1922 at Spencers Creek was confirmed.

WATER RAT (Hydromys chrysogaster): Occurring in the Snowy and Thredbo rivers, and probably in all streams and swampy areas up to medium altitudes. Feeds on mussels, snails, yabbies, water birds and eggs. Regarded as useful, as with certain birds, in destroying snails which are intermediate host of liver-fluke, and yabbies which honeycomb canal banks in irrigation areas.

Introduced Mammals.

RABBIT (Oryctolagus cuniculus): Generally though rather sparsely occurring at medium altitudes; observed most plentiful about Geehi-Grogin, and from Tin Mine to Quambat and Freebody's Hut. Would require control if too plentiful in primitive areas as both their feeding and burrowing affect indigenous fauna.

FOX (Vulpes vulpes): Seen in various localities throughout the Survey and undoubtedly the most prolific and prejudicial predators inhabiting the area. According to Mr. George Day, more than thirty foxes have been killed near the Chalet in one winter season. Widespread destruction of natural cover and activities of foxes are associated as main cause of depletion of fauna.

DINGO (Canis dingo): Reported as being widely distributed though not numerous; apparently follows sheep to highlands in summer, feeding on native fauna of lower slopes in winter. According to Mr. Day, wild dogs are difficult to poison, not being attracted to dead animals but preferring to kill their own prey, including wombats.

BRUMBY (Equus caballus): An estimate of from seven to eight hundred wild horses inhabiting the higher altitudes is quoted by Le Souef. Small groups were observed by the Survey party about Cascade, on the way from Tin Mine to Freebody's, and around the slopes of Mt. Pilot. Groups are usually of from 7 to 10 mares and foals led by a stallion; also small groups of colts driven way by it. Net increase is reported to be small, probably between 25 and 50 p.a., as late foals usually die in winter, and young colts often perish from hunger and exposure in snow-storms. The numbers observed could not be regarded as being prejudicial to general conservation, while the presence of small mobs of brumbies provides added attraction for visitors. Mass musterings in event of undue increase would, however, be most disturbing and destructive. The fire risks, casual and deliberate, would be greatly increased, and all such musterings should be properly organized and responsibly supervised.

SUMMARY.

Apart from the generally erosive effect of the annual grazing of stock, repeated firing of the bush which is evident throughout the State Park area is mainly responsible for the general biological deterioration. It cannot

be stated/...

be stated that bush fires originate mostly outside the Park, or mainly from the westward, as evident from the vast number of isolated areas of dead trees, such as impair the view opposite the Hotel, are found all along the upland route via Porcupine to the Chalet, and have transformed all the hill-tops east of the Cascades into arboreal skeleton galleries which are the immediate prelude to denudation and soil-erosion.

Evidently both planned and irresponsible firing arises from a fixed belief amongst leaseholders and their employees that consistent burning-off is an essential to improved pasturage, and the prevention of bush-fires! Behind local insistence upon the accepted right to burn-off indiscriminately is a basic and illogical intolerance of any growth not concerned with the immediate needs of pasturage. Indisputable evidence of this irresponsible attitude was provided the Survey party when, after passing through recently burnt tracts on the slopes of Mt. Pilot, bushmen in advance of the party were observed to light patches of dried grasses as a quite natural sequence to lighting their cigarettes, and in defiance of the known aims of the Survey.

In view of this attitude, and general deterioration resulting therefrom, there is imperative need, prior to the renewal of leases and permissive occupancies, for a pastoral survey by the various land and water-usage agencies to define areas which may still be utilised for grazing without endangering yet more large expanses of the State Park, and more especially such primitive areas as may be set apart for conservation of flora and fauna, and the attraction of tourists. Early inception of a long-range educational programme concerning the importance of biological control with regard to the checking of erosion is most desirable to overcome uninformed opposition, as preliminary to delimitation and adequate supervision of the various primitive areas.

In this regard it is notable that the U.S.Soil Conservation Service was recognized as one of the most potent factors for wildlife conservation within five years of its foundation. Restricting the definition of "wildlife" to denote "undomesticated vertebrate animals", their basic requirements are given by the Soil Service in the order - "cover, food, and water", since water, like food, must be in such relation to cover that animals seeking a bath or drink will not fall easy prey to their enemies. Therefore, the union of Soil and Wildlife Conservation Services in the United States is based on the fact that both depend fundamentally on the re-establishment and maintenance of vegetation. Indeed, it is emphasized in the Intra-Service Report of 1938 that "Even were there no direct relation between wildlife conservation and operations for the control of erosion...there would still be a strong obligation on the part of the Service to safeguard the wildlife resource in its campaign for the adoption of better land-use practices. This national obligation, the Report states, has been "definitely accepted by Federal land-use agencies, such as the Forest Service, the National Park Service, and Farm Security (Resettlement) Administration, whose primary functions are not concerned with wildlife conservation.

CONCLUSIONS.

Arising out of the natural history survey, and in consideration of the foregoing, with special regard to the

mammalian fauna, it may be concluded that :-

(1) A drastic deterioration of fauna, both as to variety and populations of indigenous species, has coincided with unrestricted stock-grazing and burning of vegetation. With establishment of suitable primitive areas certain attractive species, especially wallabies, could be re-introduced.

(2) Various indigenous mammals, including the platypus, koala, wombat, rock-wallaby and other kangaroos, are suitable for display in selected enclosures of natural surroundings. Apart from the faunistic value of such properly supervised colonies, their value as tourist attractions is shown by the great interest taken by visitors in the enclosure of sledge-dogs at the Chalet.

(3) There should be total prohibition of public sale of objects of flora and fauna from the State Park. In the event of undue increase of wild populations, revenue from the sale of skins may be applied for the upkeep and supervision of the primitive areas, such as in a scalp-bounty for wild dogs. Unofficial use of firearms should be prohibited under severe penalty, contrary to the present notice outside the Hotel which states that firing of guns is prohibited within a mile radius.

(4) As fire constitutes the main risk to the State Park in general, and maintenance of the primitive areas in particular, it is essential to provide an adequate organization, and reliable fire-guard or patrol service, for the prevention and control of fires. A U.S. Fire Fighters' Manual, as used in Yosemite Park, can be made available for consideration by the Kosciusko Trust. Co-operation with the Victorian authorities in such contrds appears essential because of the extent of the border, and adjacency of suitable primitive areas.

(5) Areas regarded as particularly suited for sanctuaries and primitive areas, with special regard to mammals: The area about White's River Hut, inclusive of the slopes and peak of Gungarton, and valleys each side of the Divide. Environs of the river about Geehi Hut, and possibly near Tom Grogin. The Banksia scrubs east of Snowy Creek on approach to Leather-Barrel, and the Mountain Ash forests of that Range. The environs of the Divide at Deadhorse. The Cascades Valley, and the superb Mountain Ash forests on the track from the Hut to Tin Mine. The environs of Big and Little Pilot mountains and Quambat, and the Ingeegoodbee river valley at Freebody's. Mammal prospects in several localities warrant intensive survey by a small party, less restricted as to time, transport, and stores.

(6) Tourist demand for horses, monopolized by the Survey party, stresses the growing importance of conserving the natural features of the various "trail-ways" between the areas listed above, notably the alternative routes to Geehi-Grogin, the track from Grogin to Deadhorse, on to Cascades, to Tin Mine, and the lovely track from there to Freebody's Hut. For conservation of both trails and sanctuaries, the American system of buffer or neutral zones might be considered, with the use of fire-breaks, and fire-proof fences, eliminating the wasteful brush type.

(7)/...

(7) The Tourist importance of Mt. Kosciusko in summer has been discounted hitherto in favour of winter, but recent formation of a Tourist Ministry with proposals for increased accommodation, stresses the urgency for measures to conserve the natural features of forest and alpine areas, and the natural beauties of the tracks and trailways to them.

V. REPORT ON THE ORNITHOLOGY.

The following birds were observed during the period 21st January to 9th February 1946, while I was a member of the Mt. Kosciusko State Park Natural History Survey party. Although at no time and in no one locality were birds really plentiful fifty-eight species were noted. All records are "sight".

1. ? Brown Quail (Synoicus australis La.). Tom Grogin (1800 ft.). Observed in small numbers on open grassed and swampy areas.

2. Peaceful Dove (Geopelia placida G.) Geehi to Tom Grogin. Not numerous.

3. Wonga Pigeon (Leucosarcia melanoleuca La.) Geehi (1350 ft.). One only seen.

4. Bald Coot (Porphyrio melanotus Temm.). Geehi (1350 ft.), in rushes along Geehi Creek.

5. Spur-winged Plover (Lobibyx novae-hollandiae Steph.) Geehi (1350 ft.) and Tom Grogin (1800 ft.). In small flocks on open grassed areas.

6. Banded Plover (Zonifer tricolor Viell.) Geehi (1350 ft.) and Tom Grogin (1800 ft.). In small flocks on open grassed areas.

7. Snipe (Gallinago hardwicki Gray). Cootapatamba Valley in marshy areas.

8. White-fronted Heron (Notophoyx novae-hollandiae La.) Geehi to Tom Grogin and along Murray River at Tom Grogin (1800 ft.).

9. Wood duck (Chenonetta jubata La.) Tom Grogin (1800 ft.) Two seen on Murray River.

10. Black Duck (Anas superciliosus Gm.) Blue Lake (6160 ft.) A small party of four birds.

11. Chestnut Teal (Querquedula castanea Eyton) Geehi (1350 ft.) Six seen on Geehi Creek.

12. Sparrow-hawk (Accipiter cirrocephalus Viell.) Cascade (4850 ft.) Several seen over open grassed areas.

13. Nankeen Kestrel (Falco cenchroides V.& H). Numerous above "Tree line" (6,000 ft. approx.). From an examination of ejected pellets found plentifully

over pasture/...

over pasture destroyed by Case Moth larvae, the chief food of these birds appears to be the large black Ground Weevils (Cubicorrhynchus) and the case moth larvae - the latter consumed, cases and all.

14. Lorikeet (Glossopsitta sp.). Tom Grogin (1800 ft.). A small flock feeding in tree-tops, but impossible to identify specifically.

15. Yellow-tailed Black Cockatoo (Calyptorhynchus funereus Shaw). Geehi (1350 ft.) Geehi to Tom Grogin, Tom Grogin (1800 ft.). Tom Grogin to Chalet, Cascade (4850 ft.), Cascade to Tin Mine, and Tin Mine (4100 ft.). Numerous in flocks throughout timbered country, especially about dawn and dusk.

16. Gang-gang Cockatoo (Callocephalon fimbriatum Grant). Geehi (1350 ft.) and Cascade (4850 ft.) Not numerous.

17. White Cockatoo (Kakatoe galerita La.). Tom Grogin (1800 ft.) One small flock.

18. Mountain Lowry (Platycercus elegans Gm.). Geehi (1350 ft) Geehi to Tom Grogin, Tom Grogin to Chalet, Cascade to Tin Mine, and Tin Mine (4100 ft.). Plentiful in heavily timbered country.

19. Rosella Parrot (Platycercus eximus Shaw). Dead Horse (5190 ft.). Not plentiful.

20. Blue Kingfisher (Alcyone azurea La.). Tom Grogin (1800 ft). One only seen on Murray River.

21. Kookaburra (Dacelo gigas Bodd.). Geehi (1350 ft.), Tom Grogin (1800 ft.), Cascade (4850 ft.) and Tin Mine (4100 ft.). Numerous, heard repeatedly at dawn and dusk.

22. Rainbow Bird (Merops ornatus La.). Geehi (1350 ft.) A few seen along banks of Geehi Creek.

23. Fan-tailed Cuckoo (Cacomantis flabelliformis La.). Geehi (1350 ft.). A number calling loudly and repeatedly in timber along Geehi Creek.

24. Bronze Cuckoo (Lamprococcyx plagosus La.). Several seen and heard above "Tree line" (6,000 ft. approx.). Definite specific identification was not possible.

25. Spine-tailed Swift (Hirundapus caudacutus La.) Pounds Creek Hut and above "Tree line" (6000 ft. approx.). In considerable numbers in heavy rain.

26. Welcome Swallow (Hirundo neoxena G.). Tom Grogin (1800 ft.). Numerous around Hut and barn.

27. Fairy Martin (Hylochelidon ariel G.). Tom Grogin (1800 ft.). Numerous along Murray River and around buildings.

28. White-shafted Fantail (Rhipidura flabellifera Gm.). Geehi (1350 ft.). Several in timber along Geehi Creek.

29. Black and White Fantail (Rhipidura leucophrys La.). Tin Mine (4100 ft.). One example only of this familiar bird - the "Willy Wagtail" - was observed throughout the trip.

30. Flame Robin/...

30. Flame Robin (Petroica phoenicia G.). Chalet (5,740 ft.) Dead Horse (5,190 ft.), Cascade to Tin Mine, and Tin Mine (4,100 ft.). Numerous.

31. Yellow Robin (Eopsaltria australis Shaw). Tom Grogin (1800 ft.), and Cascade (4,850 ft.). A few examples only seen; not common.

32. Whistler (Pachycephala sp.). Geehi (1350 ft.). Heard along Geehi Creek - definite identification not possible.

33. Grey Shrike-thrush (Colluricincla harmonica La.). A pair in timber at Tin Mine (4100 ft.).

34. Eastern Whip Bird (Psophodes olivaceus La.). Geehi to Tom Grogin. One seen, heard on several occasions.

35. Black-faced Cuckoo-Shrike (Coracina novae-hollandiae Gm.) Geehi to Tom Grogin, and Cascade to Tin Mine. Several pairs seen.

36. Eastern-White-face (Aphelocephala leucopsis G.). Chalet (5740 ft.). One small flock of 5-6 individuals.

37. Striated Thornbill (Acanthiza lineata G.). Geehi (1350 ft.) Numerous in dense scrub along Geehi Creek.

38. Yellow-tailed Thornbill (Acanthiza chrysorrhoea V.& H.). Chalet (5740 ft.). Numerous.

39. White-browed Scrub Wren (Sericornis frontalis V.& H.). Geehi (1350 ft.). A few only seen.

40. Speckled Warbler (Chthonicola sagittata La.). Geehi (1350 ft.). Rare.

41. Blue Wren (Malurus cyaneus La.). Geehi (1350 ft.), and Tom Grogin (1800 ft.). Common in small parties.

42. Brown Tree-creeper (Climacteris picumnus Temm.). Geehi (1350 ft.), Geehi to Tom Grogin, and Tin Mine (4100 ft.) Not common in timbered country.

43. White-browed Wood-Swallow (Artamus superciliosus G.). Geehi (1350 ft.). Several small flocks of 6-8 individuals.

44. Black-faced Wood-Swallow (Artamus melanops G.). Tin Mine (4100 ft.). Several small parties of 3-4 individuals moving restlessly from tree to tree and calling continuously.

45. Sordid Wood-Swallow (Artamus cyanopterus La.). Geehi (1350 ft.), Geehi to Tom Grogin. Numerous small parties.

46. Pardalote (Pardalotus ornatus Temm.). Geehi (1350 ft.) Tom Grogin (1800 ft.), Dead Horse (5,190 ft.), Cascade (4850 ft.), and Cascade to Tin Mine. Everywhere plentiful in timbered country.

47. Silvereye (Zosterops lateralis La.). Tom Grogin (1800 ft.) Numerous in low scrub, and feeding on blackberries and raspberries.

48. Honeyeater (Myzomela sp.). Tom Grogin (1800 ft.). In thick

contd.
48. scrub along banks of Murray River. Identity of species could not be ascertained.

49. Yellow-eared Honeyeater (Meliphaga lewini Swains.). Cascade (4850 ft.). Not numerous.

50. Red Wattle-bird (Acanthochaera carunculata Shaw). Chalet (5740 ft.), Dead Horse (5190 ft.). Cascade (4850 ft.), Cascade to Tin Mine, and Tin Mine (4100 ft.). Fairly common among Snow Gums.

51. Bell Miner (Manorhina melanophyrys La.). Cascade to Tin Mine. Numerous in timbered gullies.

52. Leatherhead (Philemon corniculatus La.). Cascade to Tin Mine. A few among timber on ridges, and at Geehi (1350 ft.).

53. Pipit (Anthus australis Viell.). "Tops" area, Tom Grogin (1800 ft.). Tom Grogin to Chalet, Chalet (5740 ft.), Dead Horse (5,190 ft.), Cascade (4,850 ft.), and Tin Mine (4,100 ft.). Common throughout open grassed areas the commonest bird above "Tree Line" (6000 ft. approx.) Fledged young near Hedley Tarn.

54. Pied Currawong (Strepera graculina Shaw). Geehi (1350 ft.), Tom Grogin (1800 ft.), Tom Grogin to Chalet, Cascade (4,850 ft.), and Tin Mine (4,100 ft.). Common in flocks, usually on timbered ridges.

55. Grey Currawong (Strepera versicolor La.). Geehi (1350 ft.), Tom Grogin (1800 ft.), Cascade (4850 ft.), and Tin Mine (4100 ft.). A few accompanying flocks of Pied Currawong.

56. Raven (Corvus coronoides V.& H.) "Tops" area, Geehi (1350 ft) Tom Grogin (1800 ft.), Tom Grogin to Chalet, Dead Horse (5190 ft.), Cascade (4850 ft.), and Tin Mine (4,100 ft.). Common in flocks.

57. White-backed Magpie (Gymnorhina hypoleuca G.). Geehi (1350 ft.), Tom Grogin (1800 ft.), Tom Grogin to Chalet, Chalet (5740 ft.), Cascade (4850 ft.), and Tin Mine (4100 ft.). Very Common.

58. Goldfinch (Carduelis carduelis L.). Tom Grogin (1800 ft.). Small flocks among blackberries.

The undermentioned areas are particularly suited to bird-life and were the richest seen during the Survey. It is suggested that, where possible, these should be retained in primitive condition in order that the birds be little interfered with. They are recommended for further detailed scientific study :-

Geehi.
Leatherbarrel Spur.
Cascade.

In view of their particular interest, it is also suggested that special efforts be made to protect the Snipe and Hawks on the "Tops" area. The latter are doing good work in the control of Case Moths attacking pasture - as indicated

above (No.13). The other species occurring above the "tree line" appear to be holding their own quite successfully.

VI. REPORT ON THE ENTOMOLOGY.

The accompanying report covers the entomological collections and field notes made during the Natural History Survey of the Kosciusko State Park between 21st January and 9th February, 1946; this work was carried out in addition to the Ornithological survey. Entomological collections were also made by Mr. K. Salter, of the University of Sydney, covering the period 14th January to 30th January, 1946.

Owing to the conditions of travel between camps, intensive collection and field-observation were possible only during the periods in camp; despite this and the fact that in few localities were insects really plentiful, specimens of some one hundred and thirty-six species were collected. These are covered in the appended list. Many of these are of special scientific interest, especially the primitive cicada - Tettigarcta crinita Dist. - of which the Australian Museum possessed very few specimens, and the native bee - Paracolletes helmsi Ckll. - which was represented only by the unique type-specimen. Other material was valuable in building up series in the collection of species represented only by two or three specimens only.

Identification of Orthoptera, Diptera, Hemiptera, and Lepidoptera was made by Mr. A. Musgrave.

Order ODONATA

Gomphidae.

Austrogomphus atrata Martin, Cascade
" unicornis Selys, Lake Albina, Blue Lake, Grogins.

Corduliidae.

Procordulia australiae Ramb., Tin Mine.

Order ORTHOPTERA.

Blattidae.

Ellipsidion australe Sauss., Tom Grogins.
Polyzosteria viridissima Shelford, Cascade.
Panesthia australis Burm., Tin Mine, Geehi.

Pyrgomorphidae.

Monistria vinosa Carl., Lake Albina, Chalet, Dead Horse, Tin Mine, Cascade.

Acrididae.

Coryphistes sp. Tom Grogins.

Oedipodidae.

Gastrimargus musicus Fabr., Geehi, Tom Grogins.
Oedalus australis Saussure, Geehi.

Tettigoniidae.

Acripeza reticulata Guer., Chalet, Hotel, Cascade Tin Mine/..

Tin Mine, Freebody's Hut - Generally throughout area.

?Polichne argentata Brunn., Tin Mine.

Order DERMAPTERA.

? Gen. et Sp., Tin Mine.

Order HEMIPTERA-HETEROPTERA.

Lygaeidae.

Daerlac tricolor Signoret., Tin Mine.

Pentatomidae.

Omyta centrolineata Westwood, Geehi.

Reduviidae.

Pirates melanolestoides Stal, Hotel.

Order HEMIPTERA-HOMOPTERA.

Cicadidae.

Tettigarcta crinita Dist., Cascade, Hotel.

Jassidae.

Stenocotis depressa Walker, Cascade.
Ledromorpha planirostris Donovan, Tom Grogins.
Tartessus ? sp., Cascade.

Coccidae.

Monophlebulus sp., Dead Horse, Cascade, Tin Mine.

Order COLEOPTERA.

Carabidae.

Sarothrocrepis luctuosa Newm., Tin Mine.
" suavis Blkb., Tin Mine.
" callida Newm. var. infuscata Sl., Tin Mine.
Philophloeus australis Dej., Tom Grogin.
" moesta Chaud., Hotel.
" puberulus Chaud., Tom Grogin.
Xanthophaea grandis Chaud., Tom Grogin.
" plagiata Germ., Tom Grogin.
Agonochila sp., Dead Horse.
? Xanthophaea sp., Tin Mine.
Hyparphax rotundicollis Chaud., Tom Grogin.
Dicrochile brevicollis Chaud., Tin Mine.
Promecoderus sp., Lake Albina, Blue L.

Erotylidae.

Thallis insueta Crotch, Cascade (bred from fungus)
" vinula Er., Cascade.

Coccinellidae.

Coccinella repanda Thunb., Chalet.
Epilachna undecimvariolata Boisd., Tin Mine.

Telephoridae/...

Telephoridae.

Telephorus pulchellus Macl., Cascade.

Buprestidae.

Stigmodera vegeta Hope, Chalet.

Elateridae.

Lacon caliginosus Guer., Tom Grogin, Tin Mine.
Conoderus australasiae Guer., Tom Grogin, Tin Mine.
" castaneipennis Macl., Tin Mine.

Cleridae.

Trogodendron fasciculatum Schr., Cascade.

Tenebrionidae.

Teremenes convexinsulcus Hope, Tin Mine.
Lepispilus rotundicollis Blkb., Hotel.
Chalcopterus variabilis Blesss., Tom Grogin.
Adelium rotundum Cart., Hotel.
" brevicorne, Blesss., Lake Albina, Blue Lake.

Cistelidae.

Tanychilus striatus Newm., Tin Mine.
Aethyssus pulchra Bates, Tin Mine.
Homotrysis cisteloides Newm., Tin Mine.

Mordellidae.

Mordella communis Waterh., Chalet.

Oedemeridae.

Sessinia australis Boisd., Tin Mine.

Passalidae.

Aulacocyclus kaupi Macl., Tom Grogin.

Scarabaeidae.

Onthophagus granulatus Boh., Geehi.
Phyllotocus erythropterus Blanch., Chalet., Geehi.
Diphucephala carteri Blkb., Geehi, Chalet.
Maechidius atratus Burm., Tin Mine.
Liparetrus callosus Macl., Chalet.
Pseudoheteronyx seticollis Lea, Chalet.
Heteronyx crinitus Blkb., Chalet.
" granum Burm., Cascade.
Automolus impressus Blch., Geehi.
Telura vitticollis Er., Tin Mine.
Anoplognathus pectoralis Burm., Chalet, Tom Grogin.

Cerambycidae.

Callidiopis scutellaris Fabr., Tom Grogin.
Stenocentrus scutellaris Oliv., Geehi.
Zygocera canosa Er., Tin Mine, Cascade.
Ancita marginicollis Boisd., Tom Grogin.

Chrysomelidae/...

Chrysomelidae.

Cadmus litigiosus Boh., Geehi, Tin Mine, Tom Grogin, Hotel.
Cadmus crucicollis Boisd. var., Hotel, Dead Horse.
" crucicollis Boisd., Hotel.
Ochrosopsis sp., Geehi.
Trachymela sublimbata Chap., Cascade, Hotel.
Chrusoptharta raucicollis Blkb., Cascade.
Dicranosterna immaculata Marsh., Tom Grogin.
Edusella chrysura Germ., Dead Horse, Tin Mine, Hotel.
Paropsisterna intacta Newm., Tom Grogin, Hotel.
Paropsis augusta Blkb., Dead Horse.
" montana Blkb., Cascade.
" lutea Marsh., ab. aegrota Boisd., Hotel.
" reticulata Marsh., Geehi, Cascade.
" sp., Geehi, Cascade.

Curculionidae.

Chrysolophus spectabilis Fabr., Geehi, Tom Grogin.
Sclerorhinus inconstans Lea, Mt. Kosciusko., Lake Albina, Blue Lake.
Pachyura australis Hope, Cascade.
Euops falcata Guer., Tom Grogin.
Poropterus bituberculatus Lea, Tin Mine.
Rhinotia haemoptera Kby., Tom Grogin.
Gonipterus sucarifrons Lea, Hotel, Geehi, Dead Horse.
Rhinaria foveipennis Pasc., Tin Mine.
Rhinaria sp., Hotel.
Prypnus quinquenodosus Gyll., Tin Mine.
Perperus sp., Blue Lake, Lake Albina.

Order HYMENOPTERA.

Thynnidae.

Hemithynnus wallasii Sm., Geehi.
Agriomvia marginilabris Guer., Geehi.

Formicidae.

Myrmecia (Pristomyrmecia) pilosula Sm., Cascade.

Mutillidae.

Ephutomorpha sp., Tom Grogin.

Bembecidae.

Bembex furcata Er., Tom Grogin.

Sphecidae.

Sphex suspiciosus Sm., Geehi, Tom Grogin.
Chlorion bilobatus Kohl, Geehi.

Tenthredinidae.

Perga lewisi Westw., Tin Mine, Dead Horse, Cascade.

Ichneumonidae.

Paniscus productus Brulle, Geehi.
? gen. et sp., Chalet (flying over bare ground).

Apidae/...

Apidae.

Paracolletes helmsi Ckll., Chalet (unique type only in museum).
Parasphecodes sp., Tom Grogin.

Order NEUROPTERA

Chrysopidae.

Chrysopa ? ramburi Schn., Tin Mine.

Order DIPTERA.

Tipulidae.

Clytocosmus helmsi Skuse, Tin Mine.
Platyphasia princeps Skuse, Tin Mine.
Plusiomyia sp., Tin Mine.
Gynoplistia ? viridithorax, Tin Mine.
Gynoplistia sp., Tin Mine.

Stratiomiidae.

Boreoides ? near subulatus Hardy, Chalet.

Tabanidae.

Scraptia sp., Cascade.
Tabanus victoriensis Ricardo, Dead Horse, Tom Grogin, Cascade.
Tabanus froggatti Ricardo, Lake Albina, Blue Lake.
" circumdatus Walker, Dead Horse, Cascade.

Nemestrinidae.

Exeretoneura maculipennis Macquart, Chalet, Tin Mine, Hotel.

Asilidae.

Stenopogon flavipennis White, Hotel, Chalet.
Neoaratus rubrithorax Macquart, Tin Mine.

Tachinidae.

Rutilia micans Malloch, Chalet.
Formosia confusa Malloch, Cascade.

Syrphidae.

Xanthogramma grandicornis Macq., Tom Grogin.
Syrphus viridiceps Macq., Chalet.

Order LEPIDOPTERA.

Oreixenica orichora orichora Meyrick, Chalet.

NOTES.

Monistria vinosa Carl. This large wingless grasshopper has previously been recorded from the upland areas of Mt. Kosciusko; its presence on the lower levels, Dead Horse, Cascade, and Tin Mine, is interesting. It was very plentiful

at Cascade/...

Braconidae.

Parasphecodes sp., Tom Grogin.

Parecollyba hofmuri Ckll., Chalet (unique type only in museum).

Chrysopidae.

contd.
Monistria vinosa Carl.

at Cascade, where it frequented the low shrubby vegetation in company with the Mountain Grasshopper (Acripeza reticulata Guer.).

Acripeza reticulata Guer. This interesting species occurred throughout the area, with the possible exception of Tom Grogins. It was amazingly plentiful at Dead Horse, where it was associated with an Aster (olearia stellulata), and at Cascade where it was associated with Leucopogon Hcokeri. On the uplands it is found among the tussock grass. Many field-notes were made of the intimidating display of both males and females; that of the male and its mode of chirping have previously been inadequately observed and recorded. It is proposed to publish an account of the behaviour of this species at a later date.

Tettigarcta crinita Dist. This extremely rare and primitive cicada was found occurring in large numbers at Cascade in association with the Snow Gum (Eucalyptus pauciflora). This remarkable species, unlike its allies is soundless, hairy, and nocturnal in its habits, hiding under peeling bark by day. Detailed field notes were made on this insect, and it is hoped to publish them later. Two further specimens were obtained in the vicinity of the Hotel - the type locality. It is suggested that, in view of the rarity of this cicada and its great scientific interest, the Snow Gums in the area around Cascade Hut where the insects breed, be rigidly preserved to provide an area for further detailed study.

Monophlebulus sp. This Mealy Bug occurred throughout the lower areas on Snow Gum (Eucalyptus pauciflora). In the area between Cascade and Dead Horse the insects (in association with the Saw-fly - Perga lewisi Westw.) were present in vast numbers on Snow Gums regenerating after bush fires, the young growth being massed with their wax-covered bodies. These two insects are having a bad effect upon the regeneration and unless their parasites recover control, which is possible, must become a serious pest to such regeneration.

Perga lewisi Westw. For notes on this Saw-fly on regenerating Snow Gums, see immediately above in connection with Monophlebulus sp. The female of this interesting insect deposits her eggs in slits cut in the leaf-tissue, watching over the eggs until they hatch, and guarding the larvae until they are large enough to fend for themselves. Larvae of possibly two other unidentified saw-flies were associated with this species on the Snow Gums.

Tabanidae. Three species of blood-sucking March Flies were collected - Tabanus froggatti Ric. occurring on the upland areas, while Tabanus victoriensis Ric. was prevalent at Tom Grogins, Dead

Horse/...

Tabanidae (contd.) Horse and Cascade and T. circumdatus Walk at Dead Horse and Cascade.

Pasture-eating Case Moth. A full report on this insect has been submitted to the Kosciusko State Park Trust, and further investigation is in progress.

Insects associated with Snow Gum (Eucalyptus pauciflora). The majority of the Chrysomelidae (Coleoptera) collected - Paropsis, Cadmus, Dicranosterna, Edusella, Trachymela, etc. and many of the Curculionidae (Coleoptera) were collected on the Snow Gum. In addition Tettigarcta crinita (Cicadidae), Monophlebulus sp. (Coccidae), and Perga lewisi (Tenthredinidae - Hymenoptera) may be mentioned. There is no doubt that a very large number of insects are associated with this tree, and their study should make a very profitable field if followed up.

Distribution. It is impossible with the data at present available from collections made in the Kosciusko State Park area to attempt any investigation of the distribution of the insect species and the relationships of those occurring at various heights above sea-level. When adequate collections have been secured over a range of seasons such a distributional survey might profitably be attempted. It is hoped, as opportunity permits, to prepare a basic list of the insects of the Kosciusko area which would form a basis for any future work.

VII. INSECT-FAUNA STUDIES.

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INTRODUCTION.

Collections in the Kosciusko region have been made on various occasions by entomologists in previous years; however, to date there has been no serious attempt to correlate either altitude, plant distribution or the topography with the insect fauna in our limited alpine areas.

A knowledge of Kosciusko must be based on visits both in summer and in winter, otherwise, one may not appreciate to the fullest, the significance of the "antarctic conditions" which prevail at higher altitudes in this country. The Kosciusko plateau lies between the Tasman Sea on the one hand, and the Australian land mass on the other, and when the full blast of wintry blizzards, which seem like a northern extension of the "roaring forties", submerge the region deep in snow, animal-life has to have found some means of survival. In the summer, there are insects flying over the flowers at Charlotte Pass, in the winter the air temperature can be 3^{o} fahrenheit, and superimposed on that vegetation stands a lofty cornice of ice twenty or thirty feet thick stacked up in the lee by the everlasting winds.

There always seems to me to be a marked difference between conditions at 5,000 ft. - say at the Hotel - and on any of the uplands over 5,600 ft.; there is a sort of "rawness" about life in the snow from the time you pass the Perisher Gap, which is in contrast even with Smiggin's. Comparative faunistic studies were made to illustrate the different types of insect community that occurred at various altitudes, and for this, the following range in altitude was selected :-

(a) From 7,305 feet to 5,600 feet.
(b) From 5,600 feet to 5,000 feet.
(c) From 5,000 feet to 3,900 feet.

What is known of the biology of this insect fauna?

(1) Do the insects, found about 5,600 feet in summer, migrate there from lower levels in the spring?

(2) Are there any species limited to this small area?

(3) Furthermore, do the insects living in the vicinity of the Hotel spend their complete life-cycle through summer and winter at 5,000 feet or are they too a temporary population which dies out when the temperature falls in winter and becomes renewed again, as insects flood into the area with the advent of Spring.

After all, insect-life has succeeded in the conquest of areas in the Northern Hemisphere where the temperature is far colder than at Kosciusko, and this low temperature is continued over a much longer period than prevails in this country. However, here we have a very small "island" of cold surrounded by lowlands in which the conditions are not so rigorous.

Subsequently, when time allows, the literature dealing with insect distribution in relation to such factors as temperature, altitude, and climate will be perused.

Systematists have in the main explored Kosciusko

for new species/...

for new species; however, that is only the beginning, for we want to find out more about the riddle of their biology. With this end in view, the first survey trip was made in February - March, 1945. On this occasion collections were made at various locations, which can conveniently be referred to as stations. These were as follows:-

(a) Diggers Creek Valley (5600-5000').

(1) Head waters;
(2) golf links;
(3) foreshores of the artificial lake at Hotel;
(4) Cassinia aculeata bushes extending through the above;
(5) various situations down the Diggers Creek Valley.

(b) Hill-sides, ridges and moors.

(6) Open heath-lands and moors known as the Plains of Heaven, above 5600 feet;
(7) moors drained by Daners and Piper's Creeks;
(8) re-growth of the Eucalypts on the slopes of Mt. Sunrise known as the Percy Pearson ski-run;
(9) the ridge to the west of Digger's Creek in the general vicinity of the saddling paddock;
(10) a stand of ring-barked timber fired and grazed so that all re-growth was destroyed.

(All between 5,600' and 5,000')

(c) The Snowy River (3,900 feet).

(11) Island Bend; and
(12) a situation not far below the junction with Finn's River.

(d) The Summit.

(13) Including the Main range and Charlotte Pass (7,305'-5,600').

A list of the insect fauna was made for each of these locations accompanied with a brief note on the environmental conditions and appropriate photographs. In this way, some picture was built up of the insect community in each of these stations. This 1945 trip has provided a quantity of most valuable material, representing the insect fauna from the Snowy at about 4,000 ft., Hotel Kosciusko at about 5,000 ft., and various parts of the uplands, with finally the Summit country at over 7,000 ft.

The survey of 1946 has added considerably to this. It made possible a brief exploration of White's River Hut district, and though the weather was against us at the time, especially for a study of insect life, it was interesting to investigate an area not so many miles from Hotel Kosciusko but different in altitude, temperature and general topography. This second trip enabled a fairly detailed search to be made of the Chalet and Foreman's Hut regions. At the Chalet, samples were taken of the insect communities typical of Spencer's Creek and also along the slopes of Charlotte Pass and Mounts Stilwell and Guthrie; while the open moors and the Snowy

River in the neighbourhood of Foreman's Hut provided a further record of the insect life taken in association with this river at its different altitudes. The brief visit to the Summit in 1945 demonstrated that several sorts of beetle and the proverbial march-flies were present there in spite of the westerly. This time we covered the region at 7,000 feet working our way through from the Summit along the Alpine Trail via Mt. Northcote, Lake Albina, Mounts Lee and Carruthers then downhill to the Blue Lake and back to the Pass.

Such a trip, however, could scarcely be called exhaustive, and I look forward to the completion of the new hut at Lake Albina.

Leaving the Alps altogether and dropping to the Geehi and then exploring Tom Grogin across the border made a further interesting comparison possible. Geehi is about 1,200 feet, while Tom Grogin's Hut is 1,900 feet and the flora is completely different from that of the tops. I should like to have spent a week at the Geehi so as to get something truly comparative at such a base. There is a great deal more to be known about this area. It is situated where westerly winds might easily assist in insect-transport, its winters are not so severe as they are up above, and lastly, it is locked in by the hills. It should yield a most interesting insect fauna.

TEMPERATURES AT CHARLOTTE'S PASS.

Prior to discussing the local variation in alpine insect distribution, it would be as well to consider the prevailing conditions of temperature both above and below the soil-surface. Winter and summer air temperatures can always be secured direct from the Bureau. As an example of temperature conditions in summer here are the maximum and minimum readings for the month of January, 1946, covering the period of this survey.

9 a.m. Meteorological Observations
made at
THE CHALET, MT. KOSCIUSKO -- Division No. 4, N.S.W.
During the Month of January, 1946.

Date	Temperatures. Maximum.	Minimum.
1st January.	75	48
2nd "	69	39
3rd "	71	41
4th "	62	42
5th "	67	40
6th "	50	38
7th "	52	32
8th "	61	34
9th "	65	33
10th "	58	43
11th "	73	59
12th "	79	56
13th "	78	48
14th "	80	59
15th "	78	50
16th "	75	50
17th "	69	51
18th "	71	55
19th "	62	50
20th "	65	46
21st "	68	48
22nd "	60	40
23rd "	65	42

24th/...

Date.	Temperatures. Maximum.	Minimum.
24th January.	62	45
25th "	61	46
26th "	53	36
27th "	60	35
28th "	66	43
29th "	72	48
30th "	75	53
31st "	77	47

In contrast to the warm days extending this year from January 12th-16th, compare the month of August, 1939, when we could not even see our ski-tips on the practice slopes and the snow lay 20 feet thick at the Chalet door.

Date.	Temperatures. Maximum.	Minimum.
1st August.	45.	34
2nd "	39	32
3rd "	38	32
4th "	37	29
5th "	40	30
6th "	41	29
7th "	39	26
8th "	34	26
9th "	32	22
10th "	31	8
11th "	29	19
12th "	32	20
13th "	34	15
14th "	40	15
15th "	33	22
16th "	37	23
17th "	35	25
18th "	35	29
19th "	34	27
20th "	32	25
21st "	35	25
22nd "	33	28
23rd "	34	26
24th "	34	22
25th "	33	22
26th "	35	25
27th "	40	25
28th "	36	29

SOIL TEMPERATURES.

The insects of Kosciusko are not exposed to the extreme cold of August's air temperatures; they live concealed during their relatively long larval history either buried in the soil, or deep in peat-moss or else within a log of timber. Consequently, in discussing insect ecology we are more interested in the subterranean temperature conditions than in the temperature of the air, no matter how low it may become.

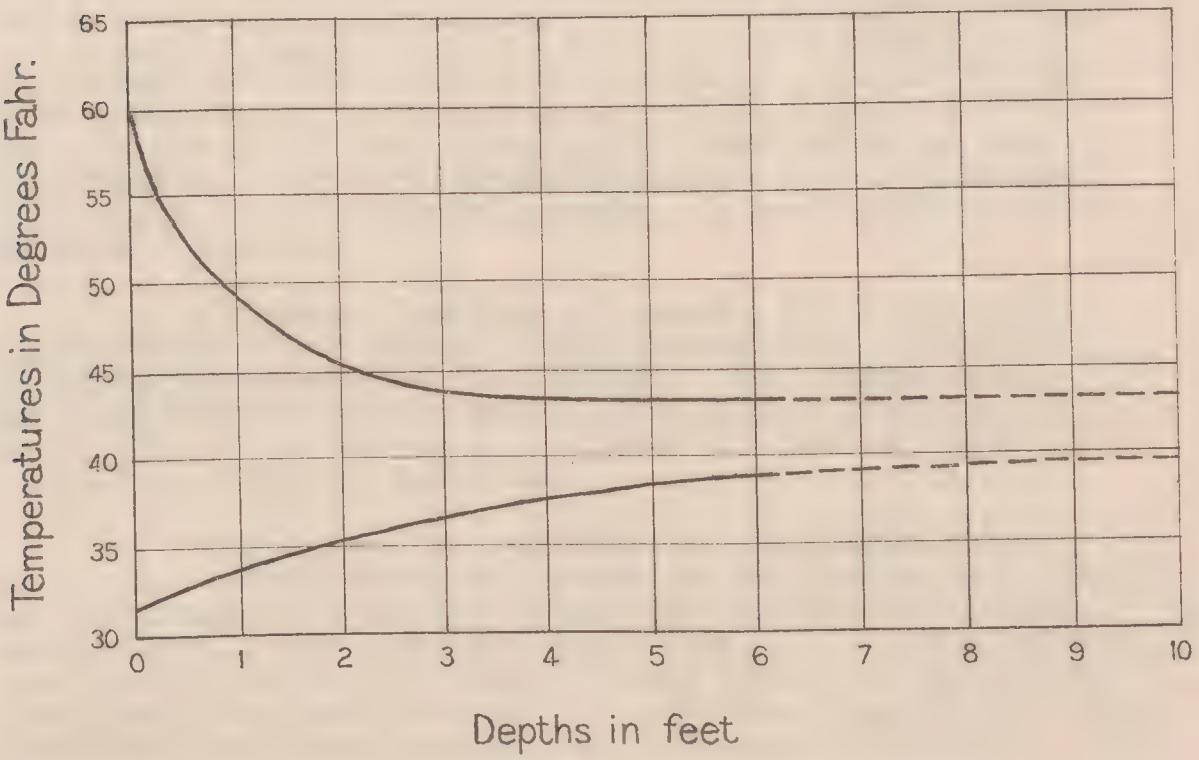
An investigation has recently been made by Dr. Dulhunty(during January 1945 and 1946) on the temperature conditions which occur at 6,200 feet not far from Seaman's Hut. (Jr. Roy. Soc. N.S.W. 80). He placed thermometers at various depths in a peat bed situated in a valley between Ethridge Range and Mt. Clark, which is a particularly frigid spot during the winter blizzards. His tabulated results are of great interest, since many of the insects spend

their larval life sheltered in soil or beneath surface cover of some sort. His tabulated results are as follows:-

Table I.

Summer and Winter Temperatures in a Peat Bed at Kosciusko.

Position in Peat Bed.	Temperature Gradients.	
	Summer - Maximum.	Winter - Minimum.
At surface	63.00°	32.00°
9 inches down	50.50	34.00
3 feet down	44.25	36.50
6 feet down	43.75	38.50



Quoting from Dulhunty :-

"Results of investigation show that during winter the temperature appears to be 32° at the surface of the soil; however, it increases rapidly with depth to 37° at 3 ft., and then rises slowly to about 41° below 6 ft. The annual variation between summer and winter temperatures decreases from about 15° at 9 inches below the surface of the ground to 8° at 3 ft. and 5° at 6 ft. Below this the rate of change in seasonal variation appears to depend on the nature of the material underlying peat or soil."

Ecology is indebted to work of this kind, and any study of the Kosciusko insect fauna requires precisely this knowledge; one must know the range of maximum and minimum temperatures which occur over the yearly cycle in such places as the peats and the subsoils. The figures are particularly interesting since many of the insects and larvae are able to withstand cold provided that their body

fluids/...

fluids do not actually freeze. Development of larval stages is withheld below a certain threshold, but there are many insects that would survive the winter in soil or timber if the minimum temperature does not drop below 37°F.

Furthermore, since the records were made from the moorlands at 6,200 feet, where conditions in a blizzard would be exceedingly severe, one would reasonably expect that along timbered hillsides, with a northerly aspect and a little shelter, soil temperatures would be quite favourable to insect development.

It is obviously necessary now to visit the Alps (preferably with an assistant) and to comb all sheltered situations for insect larvae and to try and correlate the larval stages with the adult forms which we have previously taken.

THE INSECT FAUNA FOUND IN AREAS ABOVE 5,600 FEET.

Lists are submitted of the names of insect families and the number of species representing each family for each of the stations above 5,600 feet. When all these are summarised, it is found that there are only forty different families of insects represented in that area, which is extraordinarily few, compared with results got on collecting trips in other parts of New South Wales. The forty insect families were represented by only about 77 different species, (I have grouped all doubtfuls together).

The forty families of insects and their contained species are shown in the accompanying list with locality references in two columns. The column on the left indicates locality record from upland stations, while the second column on the right indicates other records at 5,000 to 4,000 feet.

Since there is not the time to identify the collection immediately, reference to the family name with an index number to particularise the species has had to be employed. The locality frequented by each species has been listed in the left hand column, while the column on the right indicates whether the particular insect has been recorded from regions below the 5,600-foot contour.

Orders or families represented.	Localities over 5,600 feet.	Localities below 5,600 feet.
Odonata.		
Zygoptera, Species 1.	Spencer's Creek, 30/1/46.	Geehi River, 23/1/46.
Anisoptera, Species 1.	do.	Omeo Creek, Vic. 24/1/46.
Orthoptera.		
Blattidae. Species 1.	White's River, 18/1/46.	Hotel Kosciusko 2/3/45.
Gryllotalpidae, Species 1.	do.	
Acrididae, Species	Found in all stations, 1945 and 1946. Grass-land.	

Orders or families represented.	Localities over 5,600 ft.	Localities below 5,600 ft.
Hemiptera.		
Lygaeidae, Species 1.	Charlotte Pass, 31/1/46.	
Miridae, Species 1.	White's River, 18/1/46.	
Miridae, Species 2.	Mt.Stilwell, 27/1/46.	
Cercopidae, Species 1.	do.	
Jassidae Species 1.	do.	
Coleoptera.		
Carabaeidae, Species 1a.) 1b.)	White's River 18/1/46.	Not recorded. Horse yrd.ridge H.K. 22/2/45.
Species 2.	do.	Diggers Ck. H.K. 23/2/45.
Species 3.	Summit Mt.Kosciusko 29/1/46.	No record from lowlands.
Lampyridae, Species 1.	Mt.Stilwell. 27/1/46.	
Cleridae, Species 1.	do.	Not recorded from lowlands.
Buprestidae, Species 1.	White's River 19/1/46. Charlotte Pass, 28/1/46.	Very similar to forms from Digger's Creek 23/2/45.
Tenebrionidae, Species 1.	White's River, 18/1/46.	Horse yard Ridge H.K. 2/3/45.
Species 2.	White's River, 18/1/46. Summit Mt.Kosciusko 29/1/46.	Island Bend Snowy River, 28/2/45. East of Golf Links H.K. 2/3/45.
Oedemeridae, Species 1.	Plains of Heaven, 15/1/46.	Not recorded from lowlands.
Scarabaeidae, Species 1. Phyllotocus.	Charlotte Pass 28/1/46 Tom Grogin, 24/1/46.	Not recorded from H.K. on 1945 trip.
Species 2. Green.	White's River 18/1/46. Plains of Heaven 15/1/46. Charlotte Pass 28/1/46.	Hotel Kosciusko, 23/2/45. Common everywhere.
Species 3.	Summit Mt.Kosciusko. 29/1/46.	Not recorded elsewhere.
Chrysomelidae, Paropsis 1.	White's River 19/1/46.	Percy Pearson, 22/2/45.
Paropsis 2.	do.	Hotel Kosciusko.

Paropsis 3/...

Orders or Families Represented.		Localities over 5600 feet.	Localities below 5600 feet.
Paropsis 3.		Mt.Guthrie 30/1/46.	
Paropsis 4.		White's River 19/1/46.	Hotel Kosciusko
Paropsis 5.		do. Guthrie 30/1/46.	
Paropsis 6.		White's River 19/1/46.	
Paropsis 7.		Mt.Guthrie 30/1/46.	
Curculionidae.			
	1.	White's River 18/1/46	
	2.	Mt.Stilwell 27/1/46.	
	3.	Charlotte Pass 28/1/46.	
Hymenoptera.			
Ichneumonidae.			
	1.	Mt.Stilwell,27/1/46. Mt.Guthrie 30/1/46 Foreman's Hut 28/1/46. Practice Slopes 31/1/45.	No recorded sp. from sub-alps.
	2.	Mt.Stilwell, 27/1/46.	Island Bend Snowy River 28/2/45 (XXVXX)
	3.	Mt.Stilwell,27/1/46.	Not recorded.
	4.	Practice Slopes,Charlotte Pass 31/1/46.	No record from elsewhere.
	5.	Spencer's Ck.30/1/46.	Power House H.K. 23/2/45. Lake at H.K.17/2/45.
Braconidae,	1.	Mt.Guthrie, 30/1/46.	
Formicidae, Myrmecia	1.	White's River 18/1/46.	Found everywhere on range.
Eumenidae.	1.	Plains of Heaven 15/1/46	Diggers Ck.23/2/45 Golf links 14/1/46.
Apoidea.	1.	Mt.Stilwell,27/1/46.	Horse yard ridge 22/2/45.
		Charlotte Pass 31/1/46. Foreman's Hut, 28/1/46.	Diggers Ck.23/2/45.HK Island Bend,Snowy River 28/2/45.
	2.	do.	Diggers Ck.23/2/45
Diptera.			
Tipulidae.	1.	White's River 18/1/46	No record of species from
		" " 19/1/46.	lowlands.
	2.	" " 18/1/46.	Also found at Northwood(Sydney)
	3.	Mt.Stilwell 27/1/46.	Island Bend Snowy River 28/2/45.
	4.	do.	do.
	5.	Mt.Guthrie 30/1/46.	No records.
	6.	do.	Common,Diggers Ck.,Feb.,1945.
Chironomidae	1.	White's River 18/1/46	
	2.	Mt.Stilwell,27/1/46.	
Bibionidae,	1.	White's River 19/1/46.	
Tabanidae,	1.	White's River 19/1/46. Mt.Stilwell 27/1/46 Foreman's Hut 28/1/46.	Artificial lake H.K.17/2/45. Between Plains

of Heaven/...

Orders or Families Represented.		Localities over 5600 feet.	Localities below 5600 feet.
			of Heaven and the Snowy River about opposite Finn's River. 26/2/45.
Tabanidae,	2.	Foreman's Hut 28/1/46. Summit Mt.K.29/1/46. Almost everywhere on the range.	Island Bend Snowy River 28/2/45.
Stratiomyidae	1.	Plains of Heaven 15/1/45.	
	2.	White's River 19/1/46.	Hotel Kosciusko 17/2/45-3/3/45.
Boreoides subulatus.			
Empididae,	1.	White's River 19/1/46. Mt.Stilwell, 27/1/46. Charlotte Pass,31/1/46. Spencer's Ck.30/1/46.	Not on record.
Asilidae,	1.	Plains of Heaven, 15/1/46. Chalet, 30/1/46.	Island Bend,28/2/45 Lake at Hotel 17/2/45 Power House slopes, 23/2/45.
	2.	Plains of Heaven, 15/1/46.	Horse yard ridge, 22/2/45. Lake,H.K.17/2/45. Golf Links 27/2/45. Island Bend 28/2/45.
	3.	White's River 18/1/46 & 19/1/46.	Not on the records.
	4.	Mt.Stilwell,27/1/46.	An unusual type not previously taken.
	5.	Charlotte Pass,31/1/46	Not on my records.
Bombylidae,	1.	Plains of Heaven,15/1/46.	
Syrphidae,	1.	Eristalis tenax, White's River 18/1/46 Mt.Stilwell,21/1/46.	Hotel Kosciusko, 25/2/45.
	2.	Spencer's Ck.30/1/46. Foreman's Hut,28/1/46.	Hotel Kosciusko, 2/3/45 Snowy River, Island Bend, 28/2/45.
Dexiinae,	1.	White's River 18/1/46. Mt.Stilwell,27/1/46. Charlotte Pass, 31/1/46.	Island Bend, Snowy River, 28/2/45. Golf Links 2/3/45.
Tachininae,	1.	White's River 18/1/46. Foreman's Hut 28/1/46.	Lake at H.K.17/2/45. Horse-yard ridge,H.K. 22/2/45.(On the dead, sunlit, gumtrees)
	2.	(form of Tachininae,1). Mt.Stilwell,27/1/46. Charlotte Pass 31/1/46. Summit 29/1/46.	
Muscidae,	1.	Musca vetustissima, found everywhere from one end to the other of the alps.	
	2.	Calliphora stygia, common in all buildings.	
Ortalidae,	1.	White's River 19/1/46. Mt.Stilwell,27/1/46. Charlotte Pass 21/1/46. Foreman's Hut, 28/1/46.	Golf links, 2/3/45. Horse Yard Ridge, 22/2/45.

Order or families represented.	Localities over 5600 feet.	Localities below 5600 feet.
Lepidoptera.		
Nymphalidae 1.	Widely distributed.	
Lycaenidae 1.		
Various moths, Several sp.		

DISCUSSION.

The valleys of the Snowy and the Crackenback, the numerous tributaries which cut deeply into the sides of the uplands, all tend to provide insect life with immediate areas of comparative shelter at relatively low altitudes. Such valleys are situated within short distances of the higher ground and the mean average temperatures in the shelter provided by wind-fall timber, loose stones, deep in the soil, or in sphagnum moss, will be considerably milder than on the exposed, cheerless slopes, high up at 6,200 feet in the wind-swept valley that lies between Etheridge and Clark.

The relatively mild conditions prevailing at lower altitudes in close proximity to the higher ground can easily be recognised on a run down Perisher to Pounds. At Pounds Creek Hut the snow is quite soft and tending to thaw, the wind has dropped, and the sun is quite warm. The difference in winter between Pounds Creek Hut district and Charlotte Pass is considerable. Mean average soil temperatures would be certainly less severe here than higher up the mountain.

The Odonata can fly to the upland - creeks from milder haunts in the lower valley of the Snowy River. Spring aquatic collecting will throw light on their movements and there is a volume of literature written on dragon-flies.

The Blattidae, Acrididae, Gryllotalpidae, the Carabacidae, Cleridae, Tenebrionidae, Scarabacidae, and Curculionidae, and finally the Formicidae are among the hardiest of insect families. In the main, it is safe to assume that all of these forms are sheltered for the greater part of the year in the soil, or under logs and stones. The mud that results from the thaw would be the worst feature in their environment.

The Buprestids or Jewel Beetles are sheltered also in their larval stages since development takes place within the stems and roots of living trees and shrubs.

As to the Hymenoptera, the Ichneumons and the Braconids are parasitic wasps and usually spend their larval stages within the bodies of caterpillars; now there are plenty of small butterflies and moths which come up on to the highlands from the more sheltered valleys in the spring to breed on the various shrubs; their larvae are common at Charlotte Pass. Ichneumon wasps are taken usually flying over the bushes habitually frequented by the various small Lepidoptera, and on a subsequent trip it will be necessary to establish the host-parasite relationship by breeding the wasps from collections of the caterpillars. They would be able to pass through several generations perhaps in the short season, but once the cold weather sets in, both host and parasite would scarcely be likely to survive. There is most likely an annual influx establishing temporary colonization.

The ants would be permanent residents; their range

in the/...

in the Northern Hemisphere undoubtedly takes them into snow-bound regions far worse than Kosciusko.

Solitary bees, if they resemble the domestic bee, would be expected to range long distances in foraging; it would be interesting to locate their nests. If they select sites deep in the trunks of dead trees in moderately sheltered valleys, the subsequent generation should be able to overwinter in comparative comfort.

Strong winged Diptera like the Asilids, Tabanids and Dexids, the Tachinids and Syrphids, would be able to follow up the Snowy River Valley after the thaw. It is of little use guessing; until larval stages are secured in the early summer from upland regions, one cannot say whether or not these types have conquered the upper limit of their summer range. The grey, bristly, long-legged Tachinid has been taken from the Hotel to the Summit; it may be a parasitic species with quite an interesting biology.

Sweeping the flowering vegetation invariably yields three species of Ortalid and three little Trypetids; these must swarm the upper limits in countless numbers feeding on the honey.

Lastly, there were the Moths and Butterflies already mentioned in connection with the parasitic wasps, there was a small Nymphalid, a Lycaenid, and various little moths which closely followed the distribution of certain flowering shrubs from the Hotel Kosciusko to the Summit and quite possibly to the Island Bend, Snowy River.

DIPTEROUS INSECTS.

Tipulid larvae may feasibly be breeding in sphagnum and peat, they are such a common feature of the moorlands, or along the timbered hill-sides. The fact that there are six species points to their success; furthermore, minimum temperatures at 37° Fahrenheit, three feet down in a peat bog may not be unfavourable to their overwintering habits.

That Tipulids are blown up by the wind is brought out by the fact that during winter there is a small black one often found lying in the snow feebly trying to vibrate its wings.

Then there is Borcoides subulatus. This interesting Stratiomyiid with its wingless female was emerging in large numbers from the soil at the foot of an introduced tree near the tennis court at the Hotel Kosciusko between 17/2/45 and 3/3/1945. Larval and adult stages could be obtained in any quantity.

Of the five species of Asilidae, three come from the Island Bend, Plains of Heaven, White's River Hut triangle, however, the Asilid taken from Mt. Stilwell may prove to be an alpine type, future work will clear this matter. Larvae are soil-frequenting, so it may be a local resident.

THE BLOWFLY.

An entomological report on the Kosciusko area would not be complete without a brief discussion of the blowfly question.

To begin with, there are at least fifteen species of blowflies in the Commonwealth. At Kosciusko the Large Brown blowfly, Calliphora stygia is dominant, but the Lesser Brown Blowfly is also present and the little black bush-fly, Musca vetustissima, is the most irritating of all. This is somewhat like the house-fly; it ranges from the arid centre, Darwin and North Queensland to the summit of Kosciusko. Its breeding

habits/...

habits are quite unknown.

Calliphora stygia is a native species, and its dominance in the Alps is interesting because of the fact that it breeds at temperatures lower than any other Australian blowfly. According to Fuller (C.S.I.R.Bull.82) Stygia becomes active at temperatures lower, and becomes comatose at temperatures higher than any other species of blowfly in Australia. "The appearance and disappearance of the various species is directly related to soil-temperature. Emergence of Calliphora stygia commences when the maximum temperature of the soil at 6 inches is 12°C (= 54°F.), and increases as the temperature rises to 15°C (= 59°F); other species only begin to emerge when soil-temperatures reach 15°C".

It is hoped that in a future survey records can be made of the soil-temperatures and an attempt made at correlation between them and the blowfly population.

Calliphora stygia is attracted towards and oviposits on decaying animal matter, either a rotting carcase or animal and human faeces. It is one of the primary flies in blowfly strike (cutaneous myiasis), and further, it is quite unable to breed in decaying vegetable matter. The eggs hatch in one or two days into a smooth-skinned larva; this tapers anteriorly and grows to ½" in length. Its breathing apertures are situated at the posterior end. Food is taken in liquid form usually predigested by enzymes voided in the excreta; growth is unbelievably rapid. When fully fed the larva enters the wandering stage, the duration of which depends on temperature, humidity and the state of the soil. This allows the larva to reach a situation suitable for pupation.

The larvae of Calliphora stygia have been observed to travel horizontally through ordinary compact soil for a distance of ten feet before finally selecting some suitable spot in which to come to rest.

It then undergoes an alteration in shape, becoming thicker and shorter, and finally takes on the definite form of the puparium. The wall of this protective case is in fact the last larval skin which loosened itself from the body a little while before pupation took place. The puparium contracts, hardens, and darkens until it resembles a barrel; it is of great importance in the biology of the fly as it enables the developing prepupa to resist adverse weather conditions. The larva frequently comes to rest several feet beneath the soil-surface, and consequently the puparium itself is further protected from the winters by the overlying soil, the covering of herbage, and also the snow itself which rarely cools below 32°.

The adult fly is able to emerge through the soil by special adaptations suitable for the purpose, and when its wings and exoskeleton harden, it is ready to begin its adult existence. Several days elapse before the female can be fertilized and oviposition take place (Tillyard C.S.I.R.Bull No.37). About ten days are required from egg-deposition in one generation to subsequent egg-deposition in the next generation. However, the time taken to develop from the deposition of the egg to the oviposition of eggs again depends chiefly upon the weather; development is more rapid in warm weather than in cold, and whereas ten days elapse in summer, in the winter months this period lengthens considerably and the prepupa rests within its barrel-shaped puparium in hibernation. Those situated in warmer positions are readily brought to the surface as soon as the first spring thaw allows the warmth of the sun to penetrate the soil.

Since the carcases of animals and human faeces are all frozen/...

all frozen in winter they are unsuitable for blowfly maggots during that period. However, as soon as the thaw and the spring rains set in, the tissues of a dead sheep or exposed faeces become "rejuvenated" once they come off the ice, and once again approach the condition of recently dead carrion. So in the spring the whole collection of refuse of the winter season is at hand for Calliphora, and consequently a cycle of Calliphora stygia may be repeated. A spring thaw as close to the Chalet as Pounds Creek Hut in the Snowy valley would create conditions which could be quite suitable for such an early generation of this species.

The ability of insects to disperse themselves over a large area depends on the length of the adult's life and on such factors as the number of eggs deposited and the range of flight of the adult female. Calliphora can cover about eight miles in seventeen days, it can produce literally thousands of eggs, while (though no figures are to hand at the moment) the adult fly would be likely to live in the cooler alpine weather for some weeks. "Enough Lucilia (another species of blowfly) may emerge from the carcase of one single sheep to surge effectively over an area of thirty square miles". (Mackerras).

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Bonds
Dec. '11